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MANAGEMENT SERVICES

a magazine of planning, systems, and controls

A Publication of the American Institute of Certified Public Accountants

"Business deserves consumer confidence"

This past year, American consumers made 3,296,293 calls to 126 Better Business Bureaus across the country.

For every *one complaint* there were *nine inquiries*—people who simply wanted to check on the reputation or reliability of a company, or find out about some business practice.

Compare that to 30 years ago, when the opposite was true: most people called the Bureaus to *complain.*

Besides, Bureau records show that not all consumer complaints are serious or justified. Frequently even serious complaints are the result of a company's unintentional mistake.

In the vast majority of cases, whether the mistake was intended or not, the Bureaus obtain *voluntary* corrections.

Despite these favorable signs, business today faces a crucial need to do a still better job of self-regulation of advertising and selling, and to do more to inform both government and the public concerning business progress in serving customers in the public interest.

Hence the Better Business Bureaus, drawing on their unique 54-year experience, have launched an expanded action program. It features these developments:

1. Expanded Service By Individual Bureaus. In city after city BBBs are broadening the geographic areas they serve, adding more telephone lines, installing automated filing and reporting systems—so they can give more consumers better and faster service.

Increasingly, individual Bureaus are called upon to testify before state legislatures.

In some cities, Bureaus are setting up Consumer Affairs Councils to provide local forums for discussion of consumer problems.

And each year new Bureau offices are opened.

All this costs money; but it demonstrates the spirit of a great business community which understands that it can survive only if it enjoys the confidence of its customers, and which will go beyond any possible law in protecting this relationship.

2. BBBs' Research and Education Foundation. Activated under the direction of a distinguished Board of Trustees, this foundation will conduct urgently-needed studies to shed the light of objective fact on issues of concern to consumers. Under its aegis the BBB will initiate new programs to protect both the consumer and the enterprise system.

3. Office of National Affairs. This office has been opened in Washington. It will use the goldmine of information gathered by Better Business Bureaus across the nation, providing federal officials—for the first time on a systematic, continuing basis—with reliable data based on more than three million consumer contacts per year.

It will also offer facts on how business regulates its marketplace activities in the public interest, and report back to business on government activities and plans affecting business-government relations in the consumer area.

4. Stepped-Up Mass Communication. This program will express industry's concern for the consumer, explain industry's self-regulation efforts, upgrade consumer buying skills, and increase public understanding of the enterprise system.

How can you as a businessman cooperate with this expansion program?

Bear this in mind: the heart of the BBB complex remains the individual Better Business Bureau.

It works to improve the business climate, to safeguard your community's buying power and maintain a market environment in which your business can operate profitably.

And it supplies data now being relayed to both federal and state governments to show why *business deserves consumer confidence.*

Write or call the manager of your nearest BBB. Tell him your reaction to the Bureaus' expanded action program. See how you can help to make it succeed. Association of Better Business Bureaus International, Chrysler Building, New York, New York 10017.

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Paperwork based on yesterday's needs might not be providing the control you need right now. Moore has more than 2400 specialists keeping track of the day-to-day changes that go on in businesses, and how alert management stays on top of them. These are the kinds of ideas Moore can share with you. One Moore idea may be what you need.

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Improvement

The article on the freight payment plans ("Freight Payment: Cheaper by the Bank" by Sidney W. Hall, March-April '68, p. 45) omitted a recent improvement:

The Cass Bank and Trust, St. Louis 63106, pays all (not just those of members of the plan) freight bills submitted by carriers who have been instructed to send bills to them. We find it eliminates about 50 per cent more checks than the conventional plan we used previously.

R. P. Haynes, *Controller*
Berg Electronics, Inc.
New Cumberland, Pennsylvania

Apology

Dr. Edward J. Mock and I recently published an article ("Decision Models for the Acquisition of Treasury Stock") in the March-April, 1968, issue of Management Services (p. 49).

I inadvertently omitted a footnote reference to the outstanding article by Charles Ellis, "Repurchase Stock to Revitalize Equity," which appeared in the July-August, 1965, issue of *The Harvard Business Review*. The omitted reference appeared in the last three sentences of the article.

I deeply regret the oversight . . . The reference was omitted in typing the second draft, and [the omission] was never discovered in the proofing and preparation of the final draft.

Donald Hart Shuckett
Whittaker Corporation
Los Angeles, California

Puzzled

The article, "The Use of Simulation to Solve a Queueing Problem" by Richard M. Story (January-February '68, p. 58), has left the data processing students here at Eau Claire Vocational, Technical and Adult School somewhat puzzled. A report was given in our data processing applications class, and in the discussion that followed questions were raised concerning the example of simulation given in the article.

In the example the operator waiting time was reduced by 378 minutes (389 minutes with one inspector minus 11 minutes with two inspectors). This time could be used for increased production, greater efficiency, and better quality. Was this taken into consideration when determining the cost of the added inspector?

The second question pertains to the cost of labor. What exactly was included in the example? Both overhead and direct costs?

Brenda Steinke
Vocational, Technical and
Adult School
Eau Claire, Wisconsin

Clarification

[The] first question asks whether the increased production, greater efficiency, and better quality resulting from the reduced operator waiting time was taken into consideration when determining the cost of the added inspector. This certainly shows that the students studied the article with great care.

In answer, may I say, first, that greater efficiency and better quality are not a function of operator working time but rather of operator training and motivation, methods analysis, machine capabilities, supervision, and other factors. As to increased production, this may well be, under certain conditions, quite germane to the problem.

If the manufacturing situation were continuous rather than intermittent, then the cost of lost production could well over-ride the additional expense of an added inspector. However, the situation portrayed involves intermittent manufacture to stock, which presumes the operator has completed his production quota for the work in question before having the lot inspected. Consequently, no production loss ensues. There is, however, a delay in starting his next job, and this results in a cost equal to his pay for the time he spends waiting. Since the next job is presumably also manufacture to stock, no cost is attributable to a delay in completion of the lot.

In answer to [the] second question, only direct costs of labor were considered, since it was assumed that no actual change in overhead

occurred in the situation described. Had an actual change in overhead costs been involved in the selection of an alternative, they would have to be taken into account.

RICHARD M. STORY
The School
of Business Administration
The University of Connecticut
Storrs, Connecticut

Dangers of simplification

As an example of how queueing theory can be applied to everyday problems without reference to the Greek alphabet or high-powered mathematics, Richard M. Story's article ("The Use of Simulation to Solve a Queueing Problem," M/S, January-February '68, p. 58) was excellent. However, he raised a few questions and illustrated some of the dangers characteristic of a simplified approach.

An admittedly short study period of ninety minutes was used. This would be sufficient for illustrating the point if the rules were carefully followed. However, in the first simulation (Table 2, p. 60), the last operator arrived at 9:18 a.m., twelve minutes before the end of the study period. Figures 1 and 3 (p. 59) show that the longest possible time between arrivals is nine minutes. Therefore, the effect of at least one additional operator was not included in the analysis.

As the author stated, more than two iterations would normally be made before a decision would be reached. If at least fifty iterations were conducted for each situation, as he suggested, it would probably not matter that they were all different. However, in the case under discussion, one set of simulated data was used for the one-inspector situation while another set was used for the two-inspector situation. The very least that should have been done, in the absence of many iterations, would be to use the same set of simulated arrivals and service times for both situations. This can be shown by the fact that if only Simulation Number 2 had been used, the opposite conclusion would have resulted, using the author's decision criterion.

Perhaps most crucial of all was the decision criterion employed to justify the one-inspector system. The cost of the operators' waiting time with only one inspector, expressed in terms of wages only, was measured against the wage cost for an additional inspector plus any operator waiting time with two inspectors. This effectively minimized indirect labor cost, but it certainly did not optimize the firm's earnings. The cost of operator idleness must also include, in addition to the operators' wages, the loss of company earnings suffered as a result of the idleness. (The company's cost accountants, its CPA firm, or a work sampling study can quickly determine the earnings per direct labor hour.) Depending on the industry, an equally important factor could be the cost of idle machines while operators are waiting. The revenue produced, or the earnings, per machine hour may be the most relevant factor of all. If these (and other) factors were considered in the example, rather than suboptimizing by considering only payroll costs, I suspect the decision might have gone the other way, to two inspectors.

MARTIN K. MAGID
Management Services Department
Rutten, Welling & Company
Detroit, Michigan

Means of presentation

[Mr. Magid's] two initial statements have merely to do with my means of presenting a noncomplicated explanation of the subject. His own statements are prefaced with a referral to the article's recognition of the necessity of more extensive study and analysis . . . My . . . reply to Miss Steinke's letter answers his remaining statements.

RICHARD M. STORY

Correction

We very much appreciated the references to our publication, *EDP Analyzer*, in the March-April issue of Management Services. (See "New Generation EDP Control Considerations" by Robert F. Moloney, footnote 2, p. 18, and footnote 4, p. 19.)

But the references to our company name were incorrect, and I thought I should call this to your attention. It was listed as "Corning Publications, Inc." in Mr. Moloney's article.

The article was a good one. Keep up the good work.

RICHARD G. CANNING, *Publisher*
Canning Publications, Inc.
Vista, California

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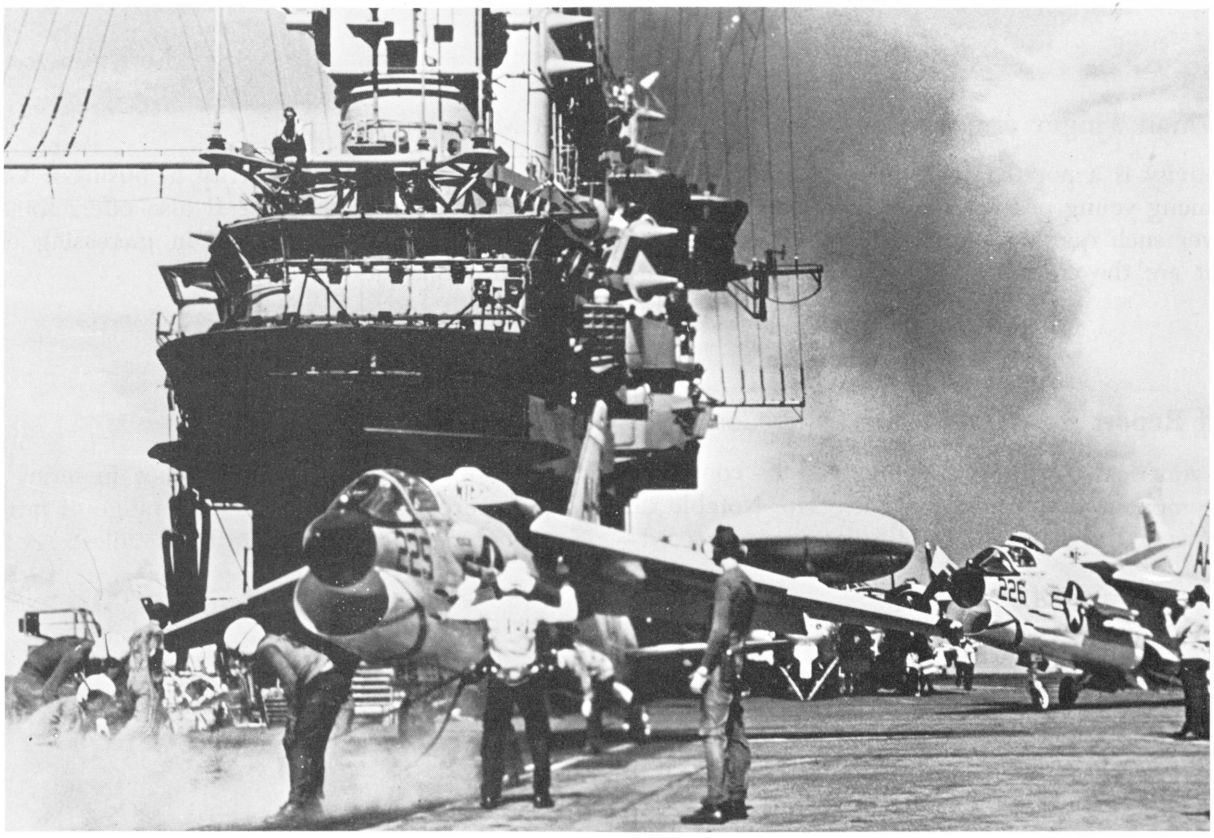

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people, events, techniques

Computer Manufacturers, Associations Attack Common Carriers' Role as 'Information Utilities' in FCC Investigation

The battle lines are now drawn in the Federal Communications Commission's investigation of data processing communications, and the next step is up to the FCC. Its action, not expected this year, is likely to have a major effect on the evolution of the so-called "information utility."

The issue, brought to a head by the growth of time sharing computer services, is who should provide remote data processing service and under what regulation. The antagonists are the data processing industry and the communications utilities.

Some 60 organizations have filed responses to the Commission's request for opinions in its inquiry into the "regulatory and policy problems presented by the interdependence of computer and communication services and facilities." (See news story M/S March-April '67, p. 12.) They include computer manufacturers (IBM, Univac, GE, Control Data), associations (the Business Equipment Manufacturers Association, the Association of Data Processing Service Organizations, the Association for Computing Machinery), computer user groups, and the United States Department of Justice, as well as the communications common carriers, Western Union and American Telephone & Telegraph Company.

Switching is 'communications'

In its statement Western Union asserted that message and circuit switching, message concentration, and circuit interconnection are historically communications functions, not data processing, and should be performed by the communications utilities. If a data processing company performed such functions for the public, Western Union argued, it would thereby become a communications common carrier subject to regulation by the FCC.

The data processing groups, of course, disagreed. Said BEMA, "Message switching, when performed incident to the prime business purpose of a data and information service, should not be regulated . . . The FCC has no power now, and should be given no power, to regulate any portion of the data processing industry."

In addition, the data processors attacked the carriers on several counts. Their equipment is often inadequate and incompatible with specific data processing equipment, BEMA argued; therefore, the carriers' "prohibitions against foreign attachment and interconnection of non-carrier devices and systems are restrictive and should be reduced."

"Common communications carriers and organizations affiliated with them," ADAPSO recommended, "should not be permitted to market data processing and other electronic information services commercially unless they first affirmatively demonstrate to the Federal Communications Commission that their prices and terms of sale will not have the effect of injuring competition." AT&T has said it does not plan to enter the data communica-

tions services field. Western Union, on the other hand, has frequently announced its intention of becoming an information utility (See news story immediately following) and is currently in the process of merging with a data processing organization, Computer Sciences Corporation.

BEMA went even further, declaring, "It may be necessary to prohibit competition from carriers in providing of data and information services or require them to compete through completely separate subsidiaries."

Carriers may be excluded

The Justice Department sided with the data processing groups on all counts. "It is our opinion that 'remote access data processing' is not common carrier communications . . . The whole question of carrier integration into the remote access data processing field . . . might ultimately require legislation . . . There is a strong case for excluding the carriers . . . so long as they continue to use their privileged position to impose tariffs restricting competition in that field."

FCC is enlisting outside experts to make recommendations on these issues. Their reports should be in some time next year.

Western Union 'Data Utility' Loses Law Suit to Law Research

Western Union's plan to create an "information utility" by combining its nationwide teleprinter network with computer centers in various cities has run into a snag. A New York State Supreme Court justice has found Western Union guilty of breach of contract in dealing with the first customer for the service.

Two years ago Western Union unveiled plans for an information system under which an abstracting service would turn its material over to WU for computer storage, and a subscriber to both the service and the Telex network could obtain abstracts he wanted simply by querying the nearest Western Union computer center. (See news story M/S May-June '66, p. 5.)

Law Research Service, Inc., signed up for a jointly operated legal citation service in March, 1966. By the summer of 1967, the organization charged in its subsequent law suit, Western Union had extended the service to only seven states, compared to the thirty-seven it had promised. Furthermore, Law Research complained, Western Union had failed to put into its computers many of the case citations compiled.

Western Union blamed the delays in loading the computer partly on the "ineptitude" of Law Research. The judge, however, found WU's "breaches of its obligations" responsible for Law Research's failure to get the number of customers up to the level Law Research had "agreed to generate in the contract."

Computer Sciences Plans Nationwide System of Time Sharing Centers

A $50-million nationwide system of twenty time sharing computer centers will be established over the next three years by Computer Sciences Corporation. CSC already operates a computer network in the Northwest and Canada (see news story M/S May-June '68, p. 7) and a remote data processing service for financial institutions in the South (see news story M/S March-April '68, p. 12).

CSC expects to open its first regional computer center in the last quarter of 1968 and others subsequently at the rate of one a month. When the system is operational, a client will be able to communicate with his nearest regional computer center via a terminal console.

The first clients for the system, CSC hopes, will be credit bureaus and collection service offices affiliated with the Associated Credit Bureaus of America, Inc. ACB of A has developed a computer package that is available to all members and will be utilized by the new CSC system. Member bureaus, however, must negotiate their own contracts with CSC.

ITT entering field

Meanwhile, International Telephone and Telegraph Corporation is also getting into the time sharing business. It will offer computer users throughout the country the opportunity to "converse" with third generation computers. The time sharing system, called the Reactive Terminal Service, is now operating in the Greater New York area and will be available nationwide within the next eighteen months, according to ITT.

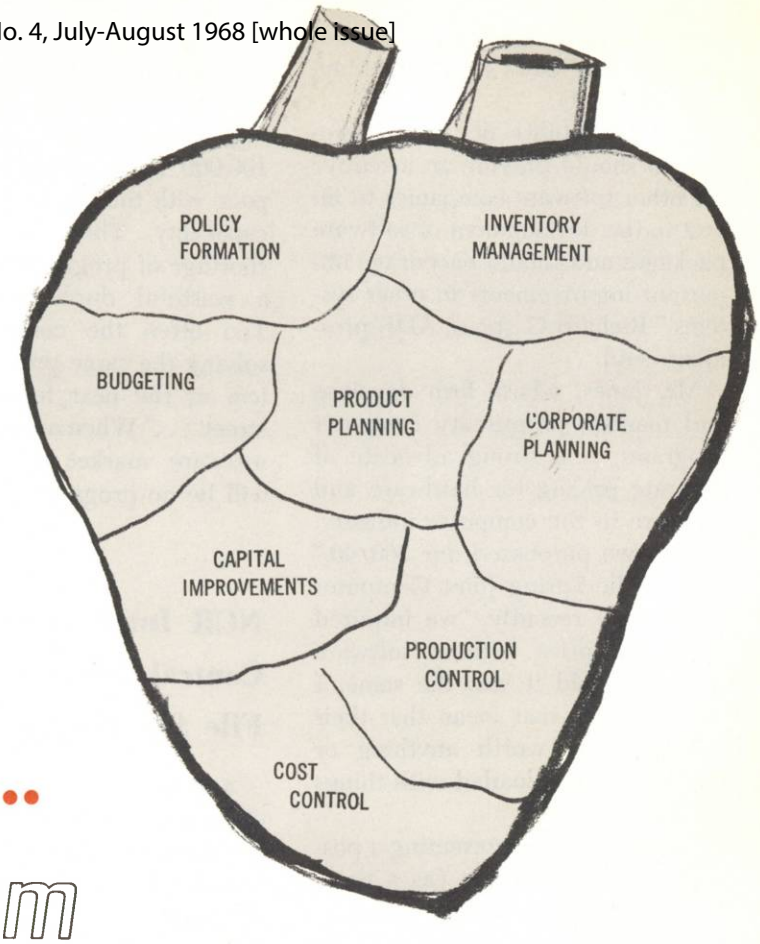
And National Cash Register Company is planning a $3-million expansion to double the size of its on line data processing network for savings banks and savings and loan associations over the next six months. The service, now available in New York, Boston, Chicago, Los Angeles, and Pittsburgh, will be extended to NCR data centers in San Francisco, Baltimore, Dayton, and Montreal and to a new data center to be opened in Atlanta.

Software Company Gets First Computer Program Patent

Applied Data Research, Inc., has been granted a patent for a computer program, a sorting system invented by Martin A. Goetz, an ADR vice president.

This is the first time, according to ADR, that the United States Patent Office has granted patent protection to an item of computer software. John F. Banzhaf III, a Columbia Law School student, suc-

the way to a client's heart.....



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ceeded in copyrighting a computer program (see news story M/S May-June '64, p. 9).

The availability of "patent protection should provide an incentive for other software companies to invest in the development of software packages and should encourage important improvements in other systems," Richard C. Jones, ADR president, said.

Mr. Jones, whose firm develops and markets proprietary computer programs, is a strong advocate of separate pricing for hardware and software in the computer industry. "When we purchased our 360/40," he told the Spring Joint Computer Conference recently, "we inquired as to the price without software and were told it was the same. I wonder—does that mean that their software isn't worth anything or that the price is loaded with things we don't want?"

In addition to representing a possible restraint of trade (as a tie-in sale), current computer manufacturer pricing practices penalize the user in these ways, according to Mr. Jones:

Equipment prices include the cost of highly specialized packages that are applicable to very few users. Since manufacturers sell equipment primarily, software that reduces equipment requirements is not in the manufacturers' interest. The present approach encourages development of overelaborate, difficult-to-use systems software that produces excessive personnel costs for the user. There is no incentive to make software more efficient or to improve its maintenance.

A competitive software market, Mr. Jones told the conference, would greatly widen the user's choices and compel the manufacturers to produce better software.

Could aid programer lack

More use of proprietary software also would solve the alleged shortage of computer programers, Lester L. Kilpatrick, president of California Computer Products, Inc., said in a recent speech before the New York Society of Security Analysts. "It has been estimated," Mr. Kilpatrick said, "that the [data processing] industry needs from 50,000 to 100,000 more programers to keep pace with the advance of computer capability. There is, in fact, no shortage of programing talent, only a wasteful duplication of effort. Too often the computer user is solving the same programing problem as the next fellow down the street. . . ." When a true competitive software market develops, "there will be no programer shortage."

NCR Introduces Central Information File for Banks

Another step on the road to the checkless society—the development of automated central information files for banks—will become a reality soon.

The National Cash Register Company is working with a pilot group of five commercial banks in pioneering the concept, which provides a detailed and quickly accessible record of a bank's entire relationship with each of its customers. Each customer is assigned a single account number, which is applied to all his transactions with the bank.

The bank can then query its computer system and quickly receive a complete report of a customer's status. This should greatly speed up credit checks and also should enable the customer to receive a single combined statement from the bank on all his transactions. For the bank, an automated CIF would have the advantage of permitting both a total marketing and a total analytical approach to the customer.

For its new Century Series of computers NCR already had developed a program for single-number account control. The bank may pick any number it wants; for example, the social security number, as recommended by the American Bankers Association (see M/S May-June '68, p. 9); the existing checking account number; or some other.

The banks participating in the pilot program are The First National Bank of Lake Forest, Illinois; The Capital National Bank of Houston, Texas; the Union National Bank of Manhattan, Kansas; The Bank of Sussex County, New Jersey; and the Citizens · Baughman National Bank of Sidney, Ohio. The first of their systems is expected to begin operating this year.

Computer Sciences offers plan

For the great mass of banks still operating in the traditional way, Computer Sciences Corporation has introduced what it says is the first package computer system for commercial loan accounting.

Commercial loans, which account for about 70 per cent of the average bank's income, are automated in less than three per cent of banks, according to CSC. One reason is the complexity of the program required. CSC's program, written in COBOL, sells for $30,000.

RCA Offers Systems Aid in Attacking Social Problems

Radio Corporation of America has formed a service group to apply systems engineering concepts to large-scale social, economic, and technological problems.

Systems engineering, which has been highly effective in many fields of technology, has "potential value in helping to define and solve some aspects of equally complex social and economic problems," according to Thomas G. Paterson, manager of the new RCA Systems Development Organization. Using recently developed information technology, it will provide a wide range of services relating to public administration, health, education, and public safety.

IBM Will Give 'Support' Services to All Users of Its Products Regardless of Where They Obtained Them

IBM has given a boost to the booming computer leasing business with its announcement that it will provide free training and other "support" services to all users of its equipment, no matter how they got it. Previously it had limited this service to so-called original users.

Leasing has become popular in the last couple of years as an addition to the standard alternatives of buying computers outright and renting them from the manufacturers. Leasing companies buy the equipment, usually from IBM, and then lease it to the user. The advantages to the user, in addition to the tax savings that may or may not accrue from any equipment leasing deal, include a discount of about 10 per cent from manufacturers' rentals – made possible by the leasing companies' belief that the operating life of a modern computer is substantially longer than the payoff period adopted by the manufacturers.

There has, however, been one catch. Under the consent decree that terminated from a Justice Department antitrust action in 1956, IBM was required to sell maintenance repair services to all owners of IBM equipment. However, it was not required to provide support services to any but the original buyer. As a result, IBM had committed itself to give these services only to the first lessor from a leasing company. The user who leased a machine returned to the leasing company by a first lessor would presumably be left on his own.

The leasing business isn't old enough for the problem to have become acute as yet. However, in anticipation of the day when it would, some leasing companies have been building up software staffs of their own.

After consultation with members of a newly formed industry group, the Computer Lessors Association, one of the leasing companies, Data Processing Financial & General Corporation, was preparing to file an antitrust suit against IBM.

The free service IBM will now supply was described as "principally customer education on IBM premises and programing systems maintenance." Computer leasing executives said they had been told it would include training, aid in planning facilities, basic operating programs, and help in correcting program faults but not "systems engineering" (help in creating programs for specific jobs). IBM considers systems engineering to be a marketing effort, the leasing executives reported.

Management Consultants' Salaries Still Rising; They Are Now Second-highest-paid Group in U. S.

Salaries of management consultants have risen sharply in the last three years, the Association of Consulting Management Engineers' fourth triennial survey on compensation for professional staff in management consulting firms indicates.

From 1964 to 1967, ACME estimates, the average annual salary of consultants in the sixty consulting firms surveyed went up 21.8 per cent, compared to 14.2 per cent during the period 1961-64. (See news story M/S November-December '64, p. 9.) These figures cover base salaries only because the bonus, profit sharing, and other extra compensation plans of the consulting firms reviewed were not considered similar enough to be comparable.

1966

How Management Consultants Stack Up

	Median Annual Salaries
Medical Doctors	$28,960
Management Consultants	15,000
Attorneys	14,750*
Economists	13,100
Chief Accountants	13,080*
Personnel Directors	13,000
Physicists	12,500
Engineers	12,500
Chemists	12,000
Mathematicians	12,000
Biological Scientists	12,000
Meteorologists	11,700
Psychologists	11,500
Anthropologists	11,500
Earth Scientists	11,400
Sociologists	11,300
Agricultural Scientists	10,000

*Mean instead of median.

Distribution of Consultants by Base Yearly Salary Ranges

(Average per cent)

Salary Range	1958 (23 firms)	1961 (25 firms)	1964 (34 firms)	1967 (60 firms)
Below $7,000	4.3	1.9	—	—
$ 7,000 - $ 8,999	19.0	8.8	4.6	2.5
$ 9,000 - $10,999	39.4	25.1	15.6	6.7
$11,000 - $12,999	18.0	23.3	21.5	15.5
$13,000 - $14,999	10.8	15.8	18.9	17.0
$15,000 - $16,999	5.2	9.8	14.9	21.2
$17,000 - $18,999	1.6	6.5	11.5	12.3
$19,000 - $20,999	0.4	4.3	4.9	8.5
$21,000 - $22,999	0.7	1.5	3.5	6.0
$23,000 and above	0.6	3.0	4.6	10.3
Total	100.0	100.0	100.0	100.0

Staff majority above $13,000

More than half the consultants in the firms surveyed were paid salaries of between $13,000 and $19,000 a year, compared to 45.3 per cent earning such salaries three years ago. (Only the salaries of professional staff who are employees of consulting firms were surveyed; partners, officers, directors, and owners were excluded.)

In 1964 more than 20 per cent of the consultants in the firms surveyed were being paid annual salaries of less than $11,000. In 1967 fewer than half as many consultants (9.2 per cent) fell into that salary bracket. Over the three-year period the number of consultants in the $15,000 to $19,000 salary range went up 26.9 per cent (from 26.4 per cent to 33.5 per cent), and the number paid more than $19,000 went up 85 per cent (from 13 per cent to nearly 25 per cent).

In more than 38 per cent of the firms surveyed the 1967 median salary for consultants was in the $15,000 to $17,000 range; in a third of the firms it was in the $13,000 to $15,000 range. Nearly 20 per cent of the firms paid median salaries above $17,000; fewer than 10 per cent paid median salaries below $13,000.

The ACME report attributes the relatively fast increase in consultants' rates of pay to the general tightness of the supply of highly skilled and experienced professional and administrative personnel. Between 1961 and 1966 the median salary of a Bureau of Labor Statistics sample of professional workers and their supervisors went up 19.8 per cent.

But consultants have done even better than other professionals. In fact, with a median annual salary of $15,000, they now rank second in a list of professionals whose median (or mean) salaries are tabulated in the ACME report. Although they fall far behind physicians' $28,960 median, consultants have edged out attorneys (with a mean annual salary of $14,750) and

rank well ahead of economists, chief accountants, personnel directors, and various types of scientists and engineers.

As might be expected, consultants' rising salaries have created some problems for the consulting firms – chiefly, how to maintain salary growth for middle-level consultants within the constraints of billing levels, how to keep compensation levels competitive with industry, and how to handle the rapid increase in expected starting salaries.

Among the other findings of the survey:

More firms now base salary increases on a combination of merit and length of service rather than on merit alone. This is a reversal of the 1964 practice.

There is a continuing trend toward lengthening of the standard work week. In three-fifths of the firms surveyed the work week is 40 hours or longer; in 1964 it was less than 40 hours in a majority of firms. Indeed, in ten per cent of the firms (all with fewer than 50 employees) the standard work week is over 44 hours.

Two-thirds of the firms do not compensate consultants for overtime work. About half, however, bill the client for it. Almost no firms charge clients for travel time outside the regular work day.

Survey Shows Majority Of Chief Financial Officers Are CPAs

Men who aim at becoming corporate chief financial executives might do well to start as certified public accountants. Among a group of 160 top financial executives recently surveyed by the National Industrial Conference Board, a majority are CPAs and more than a fourth have had experience in public accounting practice.

One-third of the chief financial executives had been promoted from the position of treasurer or assistant treasurer; one-fourth, from controller. One-fifth came directly to their present posts from outside the company.

Some of the other findings:

Seventy per cent of the financial executives have been with their present companies ten years or longer; fewer than a fifth have been there less than five years. Nine out of ten hold at least one college degree, and about one-third have graduate degrees, most often MBAs. Four-fifths belong to at least one technical or professional society – most frequently the Financial Executives Institute, AICPA, or National Association of Accountants – and three-fourths belong to one or more business, trade, or industry associations.

Fund Transfers in New York Speeded By Switching System

The New York Clearing House Association plans to install an electronic message switching system to speed up transfers of funds among the ten major New York City banks that are its members.

The new system, being developed jointly by the clearing house and Burroughs Corporation, is expected to go into operation next year. Data communication terminal devices in each bank will be interconnected through a Burroughs B35000 computer at the clearing house.

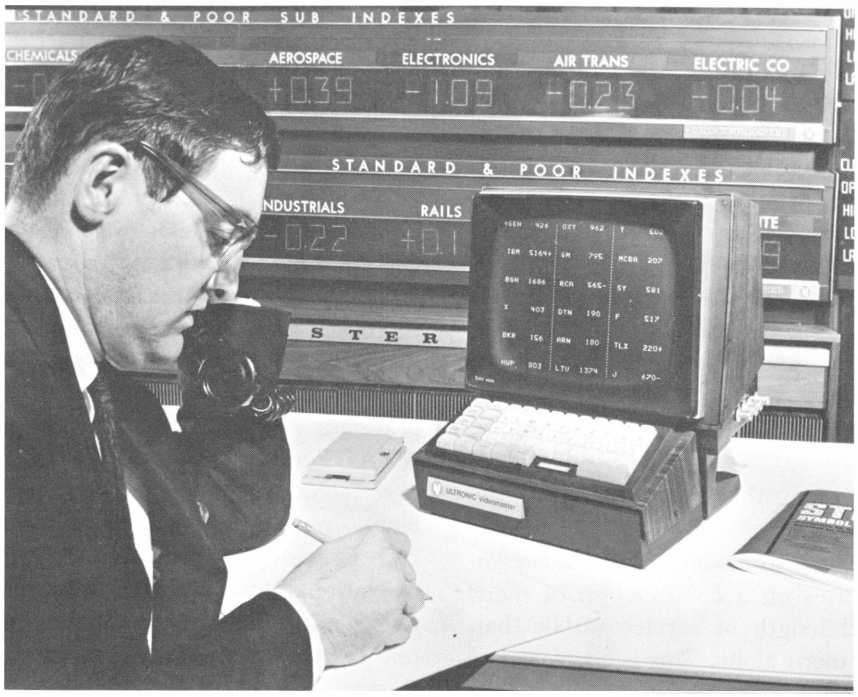
Transfers among the ten banks, made on instructions from banks and bank customers throughout the world, average about 25,000 transactions a week. During one week in March, transfers amounted to $14.2 billion. They are currently hand-delivered by messengers.

Meanwhile, the New York Stock Exchange's long-promised stock transfer service, under development for more than a dozen years, has finally gone into operation. Like the

clearing house system, it substitutes automatic bookkeeping entries for physical transfer by messenger, in this case, of stock certificates.

The Central Certificate Service's computer will handle transfer only of securities that the owners let brokerage houses hold in the firms' names. Ultimately, the Exchange hopes, that will include some 75 per cent of all stock transfers.

The switch to computerized transfer for stocks traded on the New York Stock Exchange is supposed to be completed by next year. Then American Stock Exchange stocks will be added.



New Ultronic stock quotation machine, in addition to displaying basic stock market quotation data, can monitor any 18 selected securities (as shown above) and alert the broker when one of them hits the price he is waiting for.

New Display Unit Gives Three Kinds Of Stock Information

A new graphic display unit for stock market quotations that can offer a nearly unlimited range of financial data has been introduced by the Ultronic Systems subsidiary of Sylvania Electric Products Inc.

Like other such devices, the desktop video screen brokerage unit will display the latest stock market information for a given stock when the stock symbol is keyed in. It can retrieve 17 items of information about any of more than 8,000 stocks from Ultronic's nationwide data network.

Two other modes

In addition to operation in this basic Quote mode, the new unit, the Ultronic Videomaster, can operate in two other modes: Marketminder, which enables the broker to monitor continuously the last sale price of up to 18 stocks simultaneously, and Limitminder, which flashes an indicator on the screen to notify the broker that one of these stocks has reached a price he has been waiting for.

To permit expansion, the Videomaster is technically capable of operating in seven other modes. It can be tied into the Reuter-Ultronic Report to display current news items from Ultronic's financial news service, or it can be interfaced with the broker's own computer system to retrieve any information he wants to program in.

The basic system rents for $475 a month, with an additional charge of $75 a month for each display unit.

AICPA Publishes *Auditing and EDP* as Overall Guide to Auditors Facing Machine-produced Records

A guide to the auditing of computer-produced records has been published by the AICPA.

The 344-page volume, titled *Auditing and EDP*, by Gordon B. Davis, has the following objectives: to guide CPAs in auditing business enterprises that use computers for record keeping, to provide a starting point for building an expert consensus on auditing practices for examining such companies, to suggest the utility and applicability of different auditing methods where experience is still lacking, and to provide source materials for training and informational purposes.

The book is the result of the efforts of a special Auditing EDP Task Force of Institute members with broad experience in auditing EDP. Professor Davis, on leave from the University of Minnesota as computer consultant to the AICPA, acted as chairman of the task force.

Topics covered include the organization, administration, and control of data processing; specific EDP audit procedures; integrated systems; service centers; time sharing; and training requirements for the CPA who audits computer-produced records. Appendices provide a review of the basics of EDP, list standard flow chart symbols, illustrate preferred practices in documentation, define electronic data processing terms, and present a sample questionnaire for evaluation of internal control in EDP.

(The book's contents and an evaluation of its worth to CPAs are

discussed in more detail in the article that appears on page 49 of this issue.)

Copies are available from the AICPA at $12 each for nonmembers and $9.60 for members of the Institute.

Financial Personnel Report to Local, Not National Management

Organization of the financial function is a problem for every company that operates in more than one location. Should the local financial personnel report to the local line management, or should they be responsible to the top financial executive back at headquarters?

The management consulting firm of Cresap, McCormick and Paget surveyed 101 companies ranging in size from $388 million in annual sales to $2.5 billion, all geographically if not organizationally decentralized. This is what it found:

Majority organized by units

More than three-fourths of the companies are organized by division, subsidiary, or group rather than nationally by function. In about 84 per cent of these companies local financial personnel report to local management, while headquarters exercises "functional" control through policies, procedures, audits, and occasionally the selection of personnel. The strength of this functional control varies widely.

In about 8 per cent of the divisionally organized companies local financial personnel report to headquarters. In the remaining 8 per cent some local financial personnel are responsible to local management and some to headquarters.

About 15 per cent of the companies surveyed are organized functionally. Even so, in a majority of these companies local financial employees report on a line basis to local line management.

Top Managers Ignore Time-saving Devices, Survey Indicates

The time of top U. S. business executives is among the most valuable in the world. Yet, like many of lesser rank, they often fail to use it well.

That is the conclusion reached by the management consulting firm of Daniel D. Howard Associates after surveying the working habits of 179 Chicago-area presidents and board chairmen.

More than four-fifths of the executives complained that they couldn't keep up with the literature they received. (They averaged 50 office minutes a day reading it.) Nearly three-fourths found the telephone disruptive to their concentration, and the same number were concerned about the lack of time available for planning.

Yet many of the standard solutions for some of these problems were ignored by the executives. Only 22 per cent of them said they used dictating machines; only 17 per cent said they frequently let their secretaries compose their routine letters; and nearly half said they wrote out business letters and memos by hand.

Pension Vesting, Funding Proposed in Government Plan

Opponents of tighter federal regulation of private pension plans now have something specific to object to. The Administration's proposal, the outgrowth of the work of a special Presidential study commission appointed in 1962, has been sent to Congress by the Labor Department and introduced by Sen. Ralph Yarborough (Dem., Texas).

It has three major provisions:

Vesting would be required of all pension plans. Any employee who completed ten years of service with an employer after the age of 25 would receive all the money paid into the fund on his behalf when he reached retirement age even if he had left the company before retirement.

All pension plans would have to be funded. They would be required to maintain financial reserves sufficient to pay off all the pension fund's liabilities even if the company went out of business.

A federal insurance system, paid for by employers with pension funds, would be established to give employees full protection if a plan could not meet its obligations.

Enforcement would be through criminal penalties and court injunctions rather than by loss of tax exemption.

Compulsory vesting, funding, and reinsurance have already been attacked by such groups as the Financial Executives Institute (see news story M/S January-February '68, p. 9) and the National Association of Manufacturers (see news story M/S May-June '68, p. 10).

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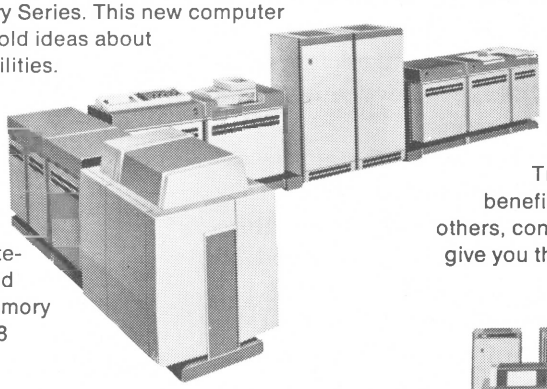

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The role of the product manager, once concerned only with building sales, has now evolved into gauging every aspect of the product's profitability. What are some of the factors he must consider?

PROFIT PERFORMANCE CONCEPTS AND THE PRODUCT MANAGER

by James D. Wilkinson
Peat, Marwick, Mitchell & Co.

In today's marketplace profits are not the automatic result of normal business activity, nor do they necessarily rise with increasing sales volume. Growth in sales may increase the probability of realizing a profit, but it does not guarantee this outcome. Sound planning and control are necessary to assure the maximization of profit.

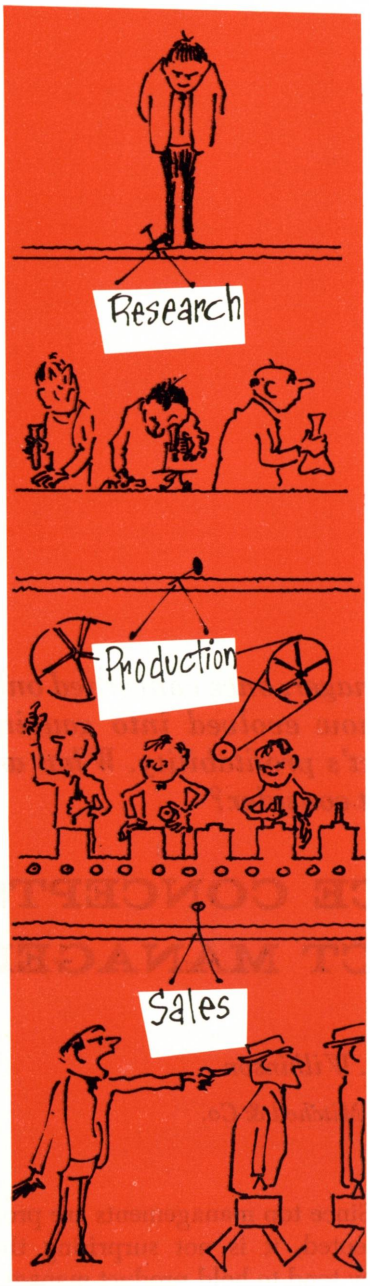
Profit control is the process of planning a profit goal, projecting profit variables based on possible levels of sales volume, and then recording performance results for comparison with stated objectives. Deviations from the objectives must be recognized, understood, and explained. Control is an implicit function of management.

In many companies the product manager is now held responsible for the coordination of every phase of his product's progress, from its concept to its ultimate sale, including the realization of a profit. For most practical purposes he may be considered the head of a complete business function within the corporate structure.

Since top managements are profit oriented, it is not surprising that they tend to hold product managers responsible for realizing the profit potential within their areas of authority. This is a change from the earlier practice of holding the product manager responsible only for increasing current sales.

Producing a profit

Corporate managers and product managers are jointly responsible for maximizing profit improvement op-



The product manager is now held responsible for the coordination of every phase of his product, from its concept to its ultimate sale.

portunities. Several courses of action can be followed successfully at the same time.

The product or product line should be examined thoroughly. Design, materials, production methods, specifications, appearance, packaging, pricing, and performance should be re-evaluated on the basis of their contribution to corporate and product objectives.

The market and competitive marketing practices for each major product should be analyzed in detail. Market trends, consumer requirements, and current marketing problems should be studied. The marketing policies and strategies of major competitors should be reviewed and compared with customers' requirements and the company's own marketing activities.

The company also may increase its opportunity for making profits by diversifying its marketing effort to take advantage of new opportunities in growing markets. These markets may require new products similar in nature to present products. Or they may involve entirely new products in no way related to present products. Diversification may seek to counteract cyclical production and sales patterns or to balance the company's marketing effort and reduce dependence on a single customer or group of customers in business or government.

The product manager must be alert to every new marketing opportunity. He must be able to present management with a detailed analysis of the new situation, a plan for taking advantage of the opportunity, and a recommended course of action to carry out the plan. In addition, he should be able to provide an estimate of the capital required to make the plan functional. Management needs to know the estimated payback period, the rate of return on investment, and the estimated life cycle of the proposed investment.

Planning and implementation

When the product manager uncovers demand for a new product, he begins to think in terms of a proposal meeting with top management. He will probably take certain steps that have become common in these circumstances.

A product proposal plan must be drafted. If management is to evaluate the proposal properly in terms of total requirements and end results, this plan should indicate all the major steps that will be necessary to realize the stated objectives. It should be based on a complete financial and operational plan for all aspects of the product, including budget programs for expense control; forecasts of market and sales; manufacturing, marketing, and financial programs and requirements; and a review of all the factors affecting return on investment. Ideally, such a plan should cover three separate time periods: preproduction requirements, short-term (less than two years) targets, and long-range or life-cycle objectives.

The plan should be detailed. It should consider and explore methods and programs by which all company functions are to participate in realizing the financial goals. Individual attention should be given to such major considerations as anticipated life cycle; sales estimates by period; manufacturing costs and capacities; service expenses; administrative, selling, and engineering expenses; capital requirements; and the cost of capital.

The estimated life cycle of each product should be discussed with as much candor as possible. The factors that may influence the projected life cycle should be evaluated and put in perspective.

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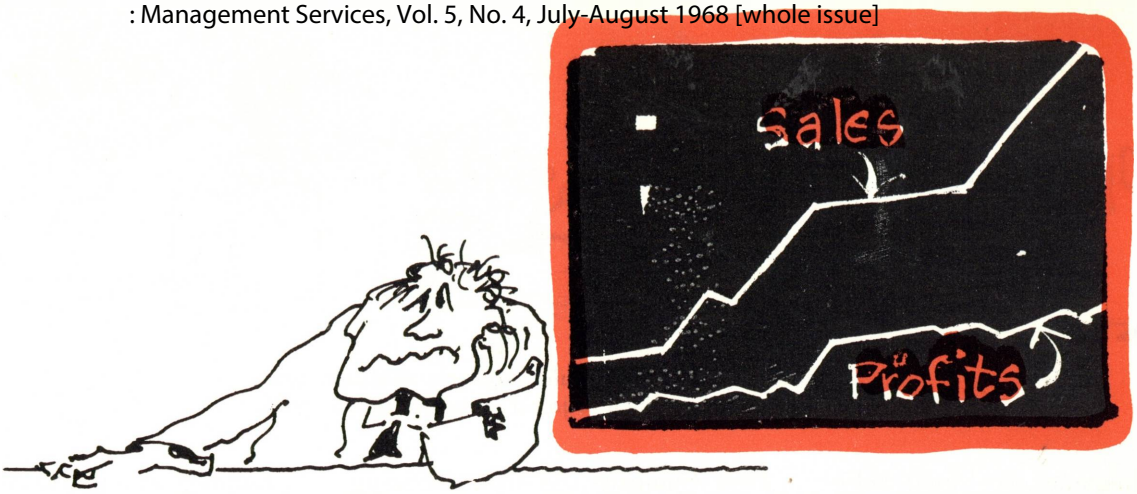


Growth in sales may increase the possibility of making a profit, but it doesn't ensure it.

Management is also interested in an evaluation of the risks involved in marketing the product. This assessment should be objective and impartial.

Prices should be developed to cover a broad range of marketing situations. These prices should be projected to indicate anticipated profits under changing circumstances of cost, competition, and demand. Price levels and discount schedules should be developed in relation to the product's life cycle and corporate pricing policies.

Measures of performance

Because of the intense competition for funds within corporate structures, management will concentrate its attention on the end result of each profit-making opportunity. Various criteria have been used for this evaluation, including qualitative judgment, sales trends, share of market percentages, and return ratios on funds invested.

In appraising performances, it is important that results be judged against a profit objective rather than against some less relevant standard such as historical sales performance.

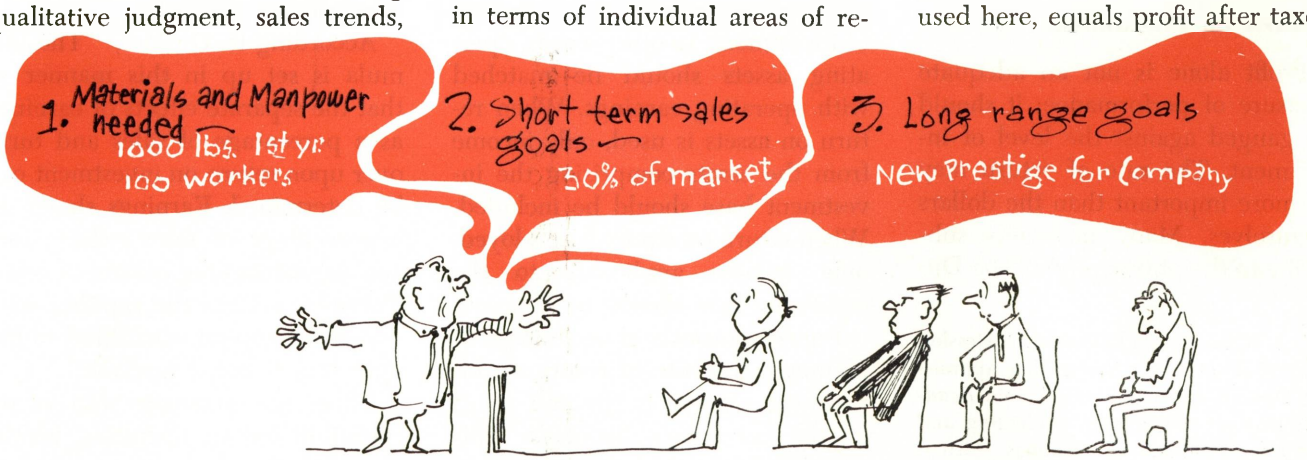
The product manager should regularly evaluate the performance of each product assigned to him against specific profit objectives. When variances occur, these must be explained so that top management may judge their significance. It is important to know how and why the variances occurred. Too often plans and objectives are developed and then not used in relating actual results to the planned objectives. A report of results that does not make such a comparison is almost worthless as a control device.

Performance should be measured in terms of individual areas of responsibility. Unless the accounting system shows results against objectives for each manager, top management will be unable to apply corrective action or dispense rewards.

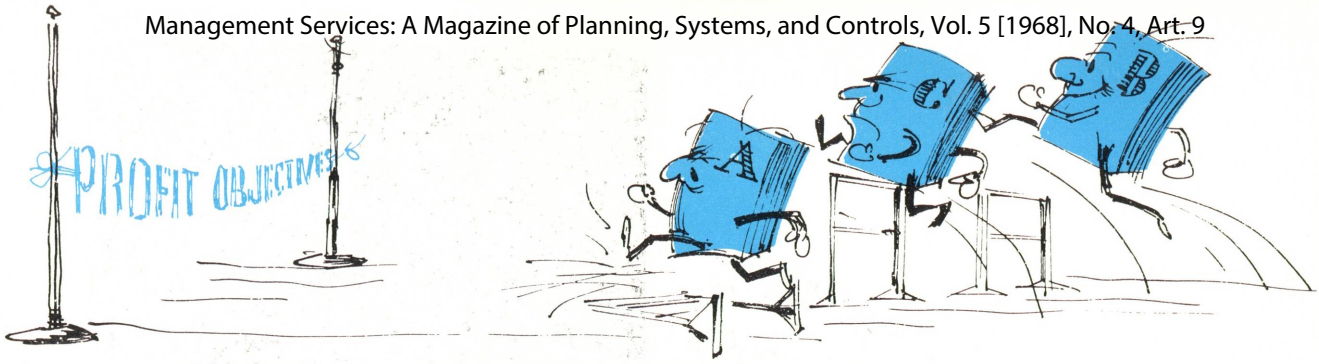
Measuring profit

While it may appear that profit is the simple result of an income-less-expense relationship, this is rarely the case. Because qualitative factors of judgment and objectives are often important in measuring profit, the same accounting conventions may not be appropriate in different instances. Within the framework of accounting by product line, there are many allocation decisions which can influence the profit reported.

Profit can be defined in several ways. The excess of income after deduction of expenses constitutes profit before taxes. Net profit, as used here, equals profit after taxes.



A product proposal plan should, ideally, encompass every phase of the project: requirements, results expected, effect on the company as a whole.



The product manager should regularly evaluate each product's performance against specific profit goal.

Some companies use profit before taxes as a guide to managerial ability on the premise that taxes are a financial consideration and not within the scope of operational decision making. This does not seem to be a proper use of tax responsibility.

The economist views profit as a surplus in excess of all costs. He measures it by the increase in the value of an enterprise from period to period, after allowing for dividend distributions and capital receipts. This gain is the result not only of operations but also of changes in asset values.

The accountant measures profit as the difference between revenue and the costs used to produce the revenue. Various allocation decisions are necessary to arrive at a figure for any interval of time.

Management generally determines profit in accordance with the accounting definition, which is oriented toward the income statement rather than the balance sheet.

Return on investment

Profit alone is not an adequate measure of performance; it should be gauged against the level of investment. The rate of return may be more important than the dollars themselves. Many managers subscribe to the philosophy[1] of the DuPont Company, "A manufacturing enterprise can best measure and judge the effectiveness of its efforts in terms of return on investment."

Return on assets (R.O.A.) is ordinarily employed as a gauge of top management performance because this total is readily available in the accounting system as the investment base. Some companies use operating assets to match operating earnings. They also may exclude assets not expected to earn a return, such as excess cash.

Return on investment (R.O.I.) is often used to measure performance by division and product managers since it permits comparison with the investment or net assets employed in producing a product or operating a division.

Return on investment is calculated by dividing earnings for the period by the investment base. There is substantial disagreement on what profit or investment base to use. The National Association of Accountants points out the importance of having the definition of earnings agree with the definition of investment. In other words, operating assets should be matched with operating earnings. When return on assets is used, only income from the assets comprising the investment base should be included. When return on equity is employed, only income applicable to the equity interest should be counted.

For the purposes of product profit planning, the rate of return on investment represents the end result of the company's activities. This rate may be broken down into two basic components:

Earnings as a percentage of sales
Turnover of investment.

Earnings as a percentage of sales is calculated by dividing earnings by sales. This percentage reflects a manager's success in maintaining satisfactory control of costs in relation to selling prices.

Capital turnover is calculated by dividing sales by total investment. Turnover reflects the rate at which capital is being used.

The product of these two produces the rate of return on investment:

(Earnings ÷ Sales) × Sales ÷ Total Investment)

This is the DuPont version of the return on investment formula. It is obvious that the formula could be more simply stated; the two sales factors could be canceled out, and the formula would read R. O. I. = Earnings ÷ Total Investment. DuPont prefers the longer version of the formula because it dramatizes the effect of both sales and turnover on the return.

According to DuPont,[2] "The formula is set up in this manner so that the separate effects of earnings as a percentage of sales and turnover upon return on investment can be determined. Earnings shown as a percentage of sales reflects success in maintaining control of costs. Turnover reflects the rapidity with which the capital committed to the operation is being worked."

Thus, the manager who is responsible for an operating invest-

[1] C. A. Kline, Jr., and Howard C. Hessler, "The DuPont Chart System for Appraising Operating Performance," from *Readings in Cost Accounting, Budgeting and Control*, William E. Thomas (Ed.), Southwestern Publishing Company, Cincinnati, 1960, p. 799.

[2] Ibid.

ment can improve his return by reducing costs or working existing investment harder. Both are factors within his control.

The life cycle of a product generally begins with the first unit of scheduled production and ends with the last sale of a production unit. Experimental models, prototypes, and field test units are not generally counted as part of the product life cycle.

To illustrate the concept of return on investment as a product performance measurement device, assume that management has invested $400,000 in a given product. Call it Product "A." At the end of the sales year, sales volume amounts to $2,000,000, and earnings are $60,000. Thus earnings are equal to $60,000 ÷ $2,000,000 or 3.0 per cent of sales. Capital turnover is equal to $2,000,000 ÷ $400,000 or 5 times.

Return on investment is 15 per cent.

Taking this illustration a step further, assume that a second product is used for comparison.

Product B requires a total investment of $350,000. Earnings for the year are $45,000 on sales of $5,000,000.

Application of the formula involved shows:

Earnings as a percentage of sales are equal to
$45,000 ÷ $5,000,000 = 0.9 per cent

Capital turnover is equal to
$5,000,000 ÷ $350,000 = 14.3 times

Therefore, return on investment = 0.9 × 14.3 or 12.87 per cent.

Thus, Product A has a higher return on investment than Product B. The product manager must analyze costs in order to improve the return for a product which appears to have good potential.

Assume that another product manager in this hypothetical company also has two products.

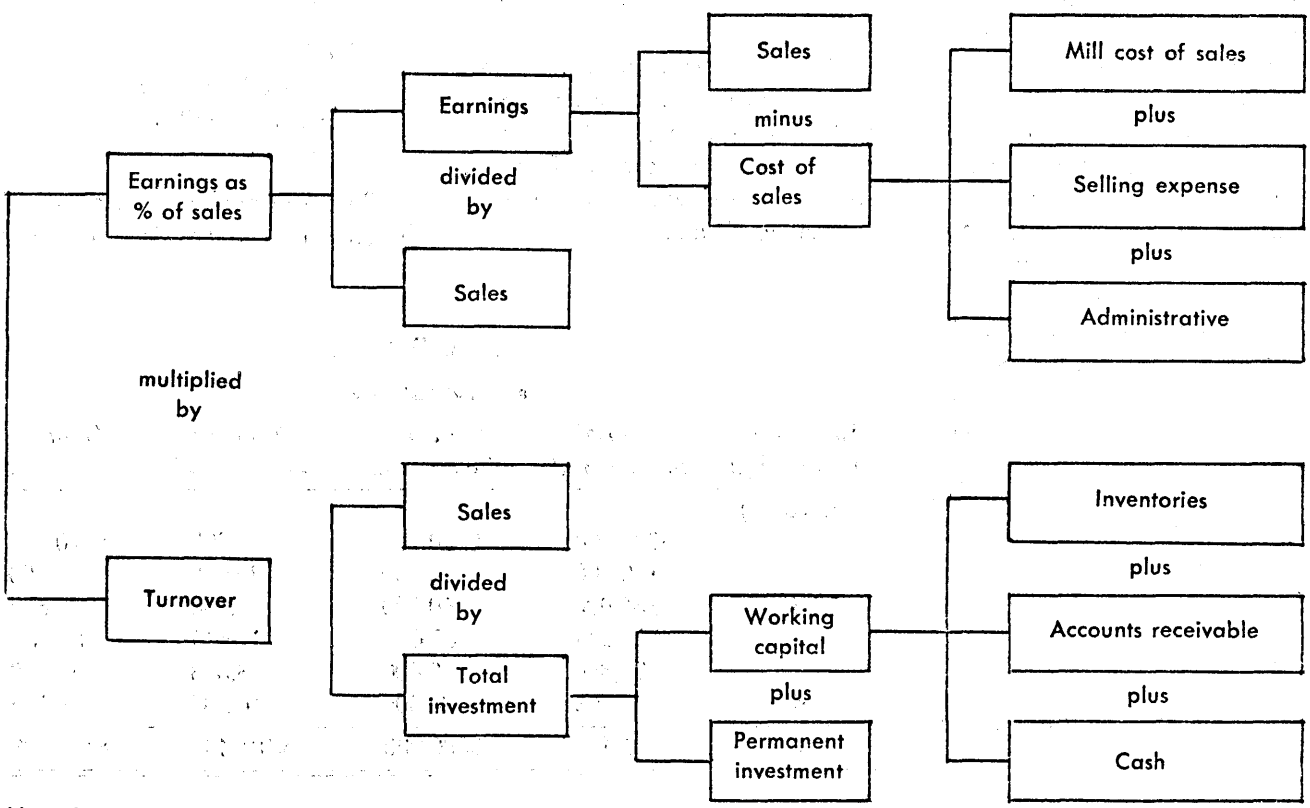
Product C requires an investment of $600,000. Annual sales are $3,000,000, and net earnings are $90,000. The return on investment is 15 per cent. Earnings are 3 per cent of sales, and capital turnover is five times.

Product D involves an investment of $200,000. Sales are $1,000,000, and earnings are $40,000. Return on investment equals 20 per cent. Earnings are now 4 per cent of sales, and the capital turnover remains five times.

Top management, using return on investment as a criterion for measuring performance, must concede that Product D is making the greatest rate of return for the funds invested. On a comparative basis, management should be concerned with improving the earnings ratios for all four products. They will probably look into the relatively poor cost record of Product B. Or

EXHIBIT I

Factors in Return on Investment



Our goal is to minimize total cost

perhaps the price of it is too low.

Management should also be careful about investing expansion funds in Products A, B, and C at this time. From these examples, it is easy to judge the reaction of management to a request for an additional $100,000 for product growth. Management would probably take a cautious approach until more information is available.

DuPont has carried its return on investment analysis a few steps farther. The chart[3] in Exhibit 1 on page 21 is a graphic illustration of the DuPont derivation of return on investment.

Earnings are shown as the remainder of sales minus cost of sales. Cost of sales is the sum of production costs, selling expenses, and administrative expenses.

Total investment is separated into working capital and permanent investment. Working capital is then shown as the total of inventories, accounts receivable, and cash.

A breakdown such as this can be used with the product examples shown earlier to identify and isolate figures and ratios that are felt to be out of line.

However, a single formula cannot contain all the elements essential to rating the performance of a product or product manager. Nor can it keep these elements in proper perspective at all times.

The illustrations cited earlier have not considered changes over a product's life cycle; high initial investment cost may be combined with low sales volume during the first year. Nor have we shown that total investment may decline as sales rise. The cost factor for management time may be disproportionately higher for a new product than an older one.

Even when a sincere effort is made to provide a rating that is truly indicative of individual performance, other considerations must be faced.

Does this performance contribute to the total corporate effort?

Has the value of interdepartmental and corporate management contributions been properly assessed?

Have special concessions or allowances been made?

Has a reasonable level of parity been maintained with other products?

Has sufficient time passed to allow the product to perform in a "normal" environment?

Payback as a measure

Payback is the most popular method used to determine the rate of return for alternative projects. The other methods of major importance are the discounted cash flow method and average return on investment. A majority of companies replying to a recent National Association of Accountants survey indicated they use more than one method in combination.

All these techniques, like the return on investment measure previously discussed, are well known to accountants. They are less familiar, however, in the context of the product manager's job.

In all three methods, it is essential to estimate the life cycle of the product.

The payback method is generally calculated by dividing the total investment by the sum of the net income estimated per year after taxes and less depreciation:

Payback Period = Original Investment ÷ Annual Cash Inflow

For example, earlier illustrations would provide this type of payback comparison:

Product A
Payback Period =
$400,000 ÷ $60,000
= 6.7 years

Product B
Payback Period =
$350,000 ÷ $45,000
= 7.8 years

Product C
Payback Period =
$600,000 ÷ $90,000
= 6.7 years

Product D
Payback Period =
$200,000 ÷ $40,000
= 5.0 years

Thus, the payback period is the length of time required for cash

EXHIBIT 2

Projected Cash Flows

Anticipated product life	*Capital unrecovered*	*Return on investment*	*Effective Interest @ 20%*	*Capital recovered*
(in years)				
1	$200,000	$ 60,000	$ 40,000	$ 20,000
2	180,000	60,000	36,000	24,000
3	156,000	60,000	31,200	28,800
4	127,200	60,000	25,440	34,560
5	92,640	60,000	18,528	41,472
6	51,168	60,000	10,234	49,766
7	1,402	$360,000	$161,402	$198,598

[3] Ibid.

EXHIBIT 3

Adjusted Projected Cash Flows

Anticipated product life	*Capital unrecovered*	*Return on investment*	*Effective Interest @ 19.9%*	*Capital recovered*
(in years)				
1	$200,000	$ 60,000	$ 39,800	$ 20,200
2	179,800	60,000	35,780	24,220
3	155,580	60,000	30,960	29,040
4	126,540	60,000	25,181	34,819
5	91,721	60,000	18,252	41,748
6	49,973	60,000	9,945	50,055
		$360,000	$159,918	$200,082

produced by an investment to repay the original cash outlay. The payback formula does not provide for formal consideration of alternative uses for these funds. However, interest charges for the money invested should be included as part of the investment cost. Companies generally feel that the payback period should be reasonably short in order for the venture to be profitable. Sometimes the competition for funds within a corporation is sufficiently great that only projects with very short payback periods receive consideration. In many cases the major factors of comparison are size of total investment, length of payback period, and estimated economic life cycle of the investment.

Because of uncertainties involved, payback is little more than a general guideline. It is not a measure of profitability, merely of anticipated performance.

Discounted cash flow method

Discounted cash flow is the second most popular method of investment evaluation. It attempts to show the rate of return on the unrecovered capital of each accounting period rather than on the initial investment. When applied to a capital investment, each of the periodic cash flows represents a partial recovery of the investment and also yields a return.

As stated by the N.A.A., "The rate of return may be defined as the maximum rate of interest that could be paid for the capital employed over the life of the investment without loss on the project." The procedure involved in these calculations is the same as that used in estimating annuity income. This method takes into account the fact that money received earlier has a greater value than money received at a later date. The return on investment in this method is that rate which equates the sum of the present values of a series of future cash flows to the value of the original investment.

The formula involved is:

$$Ao = R\overline{a}_{\overline{n}|i}$$

"Ao" equals the total investment.

"R" equals annual earnings.

"$\overline{a}_{\overline{n}|i}$" equals the present value of an annuity due of $1 per period.

"n" equals the number of years of anticipated product life.

"i" equals the effective rate of interest for the period.

For purposes of illustration, a table is used to show application of the formula to a product with the following characteristics:

The total investment required equals $200,000.

Return on investment or net annual cash inflow amounts to $60,000.

The effective interest rate or cost of the investment capital is 20 per cent per year.

The life cycle of the product is estimated at six years.

As shown in Exhibit 2 on page 22, a part of capital investment is still unrecovered at the end of the sixth year of the product's life cycle. If the product has become obsolete, as forecast, $1,402 of the original investment has not been recovered. In other words, the product cannot afford an effective interest rate of 20 per cent under the conditions projected.

Under a trial and error system of projection often used with the discounted cash flow method, the table can be adjusted as shown in Exhibit 3 above.

The table now shows that the company can afford an effective interest rate of 19.9 per cent per year and recover its total investment within the life cycle of the product.

At this point, it can be seen how changing the elements of the table will influence recovery of the investment.

If the product life cycle is extended, the company can afford more interest on its capital. Or,

vide additional profit if it continues to have a useful life beyond the cycle projected.

On the other hand, a constant return on investment has been projected. Under normal marketing conditions the company should expect a lower return during the first year of distribution when expenses are greatest and a higher return during the second, third, and fourth years of the life cycle. Under these conditions, unrecovered capital and interest paid would be much lower during the fifth and sixth years.

Then, too, there is the possibility that the product cycle was overestimated and that it may not endure through a fifth year. Competition may make the product obsolete in a shorter period of time. The point to be made is this: The product must pay for the capital invested in it. However, if this capital recovered by the product will cost interest more quickly than estimated, the product is entitled to record a profit sooner. If the product does not live up to the product manager's expectations, the product must pay a higher rate of effective interest. This is truly a "pay as you go" system.

If the discounted cash flow method is used to illustrate how Product D of previous examples might have fared at two selected effective interest rates, the table would show the results illustrated in Exhibit 4 below.

Average rate of return method

The average rate of return method has been given many names. Sometimes called "the financial statement method" or "unadjusted return on investment," it also is frequently referred to as the "accounting method."

Under normal circumstances, total investment for a product may not involve depreciation in the same sense that it does with equipment.

EXHIBIT 4

Cash Flows At Two Interest Rates

Anticipated product life	*Capital unrecovered*	*Annual cash inflow*	*Effective Interest @ 10%*	*Capital recovered*
(in years)				
1	$200,000	$ 40,000	$ 20,000	$ 20,000
2	180,000	40,000	18,000	22,000
3	158,000	40,000	15,800	24,200
4	133,800	40,000	13,380	26,620
5	107,180	40,000	10,718	29,282
6	77,898	40,000	7,790	32,210
7	45,688	40,000	4,569	35,431
8	10,257	40,000	1,026	38,974
		$320,000	$ 91,283	$228,717
			@ 6.0%	
1	$200,000	$ 40,000	$ 12,000	$ 28,000
2	172,000	40,000	10,320	29,680
3	142,320	40,000	8,539	31,461
4	110,859	40,000	6,652	33,348
5	77,511	40,000	4,651	35,349
6	42,162	40,000	2,530	37,470
7	4,692	40,000	282	39,718
		$280,000	$ 44,974	$235,026

The formula states: and inexact for many purposes.

Rate of Return = (Annual Gross Earnings − Annual Depreciation) ÷ Investment

$$R = (E - D) \div I$$

This method of reckoning return on investment has not been used to a great extent by corporate finance staffs for estimating project returns. It has been used for estimating the rate of return on equipment purchases.

As an illustration, assume that a piece of equipment costs $5,200, has a five-year life, and will provide estimated savings of $2,000 per year before depreciation. In calculating return on investment, figures replace the formula in this manner:

$$R = (\$2,000 - \$1,040) \div \$5,200$$
$$= \$960 \div \$5,200 = 18.46 \text{ per cent}$$

Under normal circumstances total investment for a product may not involve depreciation in the same sense that it does with equipment. Equipment may have a trade-in value at the expiration of its depreciated life. However, special equipment purchased solely for production of a new product may also have a trade-in value. This may be true of other goods and services used in producing or marketing the product such as promotional materials, art work, displays, office machines, general purpose equipment, and so on.

In this event, the annual gross earnings of the product are reduced by the average annual description allowance.

As an illustration, the formula can be applied in this manner:

$$R = (\$60,000 - \$5,000) \div \$200,000$$
$$= 27.50 \text{ per cent}$$

In this example the total investment is $200,000, the annual gross earnings of the project are $60,000, and the cash value of the assets to be depreciated amounts to $30,000. The life of the project is estimated at 6 years.

The value judgments involved in application of this formula to return on investment of a product program make it both unwieldy

Objectives, goals, and policies

The product manager may reasonably say at this point, "So what? What does it all mean to me? What do I get out of all these fancy formulas besides a headache?"

An essential ingredient of management is the ability to make a profit. Increased profit is not the natural result of increased sales. Therefore, if a product manager is, in fact, the delegated executive with complete responsibility for success of a particular product, he is also the primary source of profit-making potential.

As the manager of record, he is charged with obtaining an adequate return on the funds invested. His product is competing with other products for investment and expansion funds. He is in competition with other product and division managers for increased responsibility. The gauge of performance most likely to be used in any objective evaluation is return on investment. This spells out the essence of most product managers' objectives.

Particular goals must be established according to a formalized plan by the product manager. They must be realistic as well as opportunistic and aggressive. They must be communicated to those responsible for any part of the program. This includes people in production, sales, engineering, finance, and so on.

As the manager of a small business operating under the corporate umbrella, the product manager must exercise judgment in establishing objectives and goals that maximize the company's opportunity to grow and improve its corporate image. In this way, he will increase the prestige of his own activity and share in the benefits of company success. This should include greater responsibility, better position, and increased income. This, then, is what he gets for his effort.

If a product manager is, in fact, the delegated executive with complete responsibility for success of a particular product, he is also the primary source of profit-making potential.

A number of variables go into a manufacturer's decision whether it is cheaper to buy or make a component of his finished product. The authors describe two methods of finding the right answer.

TO BUY OR TO MAKE?

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THE TERM "make or buy analysis" is commonly used to describe special studies designed for the evaluation of alternatives involving the manufacture or purchase of products and parts. The alternatives available to a firm within this framework can be classified as follows:[1]

1. Make or buy a product (or a component) the firm is not currently making.
2. Continue to make or begin purchasing a product the firm is currently making.
3. Make more or less (or buy more or less) of a product the firm is currently making.

The first class of make or buy alternatives will usually involve the commitment of long-term funds; thus, it is essentially a capital budgeting problem. The second class of alternatives may or may not require long-term commitments. If no capital outlays are required and the make or buy decision involves only one product, an incremental cost analysis will usually provide sufficient quantitative data for both the second and third class of alternatives.[2] We are not suggesting that qualitative factors such as quality of the product, reliability of the vendor, etc., are not important considerations. But we shall assume that these factors do not affect the

[1] See H. Bierman, Jr., *Topics in Cost Accounting and Decisions*, McGraw-Hill Book Company, Inc., New York, 1963, p. 163.

[2] Gordon Shillinglaw, *Cost Accounting Analysis and Control*, Revised Edition, Richard D. Irwin, Inc., Homewood, Illinois, 1967, p. 639.

choice between external supply and internal manufacture.[3]

In this article we consider a short-run case which might be classified under both the second and third classes of alternatives. We are considering a firm which has the capabilities and the capacity to manufacture all products internally but also has the opportunity to purchase the same products from an outside vendor. We will not consider any possibility of changing plant and equipment; thus the capital budgeting aspects of the make or buy alternatives can be disregarded. The question is whether the firm should buy the products from a vendor, make them internally, or use some combination of make and buy.

The analysis suggested in this article is quite general and may be extended to more complex situations;[4] we use a special example, however, to carry the argument and make the link between the suggested approach and the more familiar cost accounting approach. We begin by presenting the problem, then consider the cost accounting approach, and finally make the link to a linear programing model.

The problem

Consider a small firm with two departments. In each department the normal operating time is 40 hours per week. Department 1 has fifteen machines with a normal operating time of 600 (15 × 40) machine hours per week. Department 2 has eight machines, or 320 (8 × 40) available machine hours per week.

The firm has a certain demand for its two products, each of which it can make or buy. For the present planning period there is a certain weekly demand for 5,000 units of the first product and 4,000 units of the second product. For the firm's own facilities, the required usage co-efficients (machine hours required for each unit of output) are given as follows:

	Machine Hours Per Unit	
Product	*Dept. 1*	*Dept. 2*
1	.1	.2
2	.3	.2

The firm would like to produce and purchase in a manner enabling it to meet the demand for the products at the least cost. It is assumed that the capital requirements for the alternatives to be considered do not differ significantly and can be ignored.

The cost accounting section of the firm has made available the following cost estimates:

Variable Cost Per Machine Hour	*Regular Time*	*Over-Time*
Department 1	$10.00	$15.00
Department 2	$12.00	$18.00

The raw materials costs for Products 1 and 2 are $10 per unit and $5 per unit, respectively. An outside vendor has offered to supply the firm with any quantity of Products 1 and 2 at $18.00 per unit and $12.00 per unit, respectively.

Before considering the cost accounting approach to the problem, let us indicate the decision alternatives of the problem. The firm can manufacture varying quantities of Products 1 and 2; hence there are two decision variables. Varying hours of overtime can be used in the two departments, which gives us two additional decision variables. Finally, the firm can purchase varying quantities of Products 1 and 2 from the outside vendor. Thus, there are six decision variables in the problem as given; any solution to the problem must specify these six quantities. We begin by indicating how a cost accountant may obtain a solution of the problem.

Cost accounting approach

The cost accounting approach to this problem would require a careful comparative analysis of incremental costs relevant to all available alternatives. Such an analysis may well follow the format shown in Table 1 above.

Making the products is clearly the better alternative if output during regular operating time were sufficient to meet demand. A brief investigation will reveal that the capacity available during normal operating hours is not sufficient. (See Table 2 below.)

Thus, if no outside purchases are made, overtime is required in both departments to meet the given demand. Since overtime use of the firm's facilities is an available alternative, variable costs per unit produced on overtime must be established, as shown in Table 3 on page 28.

Table 3 would indicate that it is advantageous to buy all units of Product 2 that must be produced on overtime in both departments. To obtain the cost data for all the possible alternatives we still have to consider the combination of units

TABLE 1

Variable Manufacturing Costs Per Unit During Regular Operating Time

	Product 1	*Product 2*
Dept. 1	.1 x $10.00 = $1.00	.3 x $10.00 = $3.00
Dept. 2	.2 x $12.00 = $ 2.40	.2 x $12.00 = $ 2.40
Raw Material	$10.00	$ 5.00
Total Per Unit	$13.40	$10.40

Product 1		*Product 2*	
Purchase Price	$18.00	Purchase Price	$12.00

TABLE 2

Analysis of Machine Hour Requirements

	Dept. 1	Dept. 2
Product 1	500	1,000
Product 2	1,200	800
Total	1,700	1,800
Normal operating capacity	600	320
Required overtime hours	1,100	1,480

[3] For a good listing of relevant qualitative considerations see: R. I. Dickey, Editor, *Accountant's Cost Handbook*, Ronald Press Company, New York, 1960, pp. 19/14-15 or Harry Gross, *Make or Buy*, Prentice-Hall, Inc., Englewood Cliffs, N. J., 1966.

[4] We comment on generalizations later.

TABLE 3

Variable Manufacturing Costs Per Unit During Overtime

	Product 1	Product 2
Dept. 1	.1 x $15.00 = $ 1.50	.3 x $15.00 = $ 4.50
Dept. 2	.2 x $18.00 = $ 3.60	.2 x $18.00 = $ 3.60
Raw Material	$10.00	$ 5.00
	$15.10	$13.10

TABLE 4

Variable Manufacturing Costs Per Unit Regular Time in Dept. 1, Overtime in Dept. 2

	Product 1	Product 2
Dept. 1	.1 x $10.00 = $ 1.00	.3 x $10.00 = $ 3.00
Dept. 2	.2 x $18.00 = $ 3.60	.2 x $18.00 = $ 3.60
Raw Material	$10.00	$ 5.00
	$14.60	$11.60

TABLE 5

Variable Manufacturing Costs Per Unit Overtime in Dept. 1, Regular Time in Dept. 2

	Product 1	Product 2
Dept. 1	.1 x $15.00 = $ 1.50	.3 x $15.00 = $ 4.50
Dept. 2	.2 x $12.00 = $ 2.40	.2 x $12.00 = $ 2.40
Raw Material	$10.00	$ 5.00
	$13.90	$11.90

TABLE 6

	Dept. 1	Dept. 2
Overtime Used	1,100	1,480
Per Unit Requirements of Product 2	.3	.2
Corresponding Units of Product 2	3,667	7,600

produced on overtime in one department and regular time in the other. (See Tables 4 and 5 above.)

Thus, any combination of overtime in one and regular time in the other department yields production costs which are lower than the purchase price.

Having obtained the relevant cost data, a cost accountant would now proceed to search for the least cost combination of making and buying.

As a first step we consider the alternative of making all the demanded products with the firm's facilities. Table 3 shows, however, that all units of Product 2 produced on overtime have a unit cost ($13.10) that exceeds the purchase price ($12.00). Obviously we could reduce costs by buying some units of Product 2. As a first step we would probably buy enough units of Product 2 to eliminate its production on overtime in one department. (See Table 6 above.)

By buying 3,667 units of Product 2 we would eliminate all overtime in Department 1; the remaining 333 units of Product 2 would be made during regular operating hours. The results of this decision can now be summarized as follows:

Make:	5,000 units of Product 1
	333 units of Product 2
Buy:	3,667 units of Product 2
Overtime:	
Dept. 1	zero
Dept. 2	$.2 \times 5{,}000 + .2 \times 333 - 320 = 747$ hours

Now we should find out whether this solution could be improved by buying additional quantities of Product 1 or Product 2. In our simple example we refer to Tables 3, 4, and 5. Here we find that

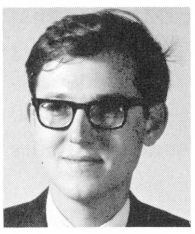
1. The total cost of Product 1 cannot be reduced by buying, since all combinations of manufacturing costs are less than the purchase price.
2. Buying additional quantities of Product 2 would mean [illegible] production at a unit cost which is less than the purchase price. We have therefore arrived at a minimum cost solution.[5]

We have shown that the intuitive yet systematic approach of what one might call traditional incremental cost analysis leads to an optimal solution of our relatively simple problem. It should be apparent, however, that the approach is rather laborious even under our simple assumptions of only two departments and two products. The number of alternatives to be analyzed would, of course, be vastly greater if we assume a more complex situation, and practical limitations would soon make the traditional approach impractical.

Linear programing

The simple illustrative problem permits us to make an interesting observation. Our cost accounting approach is actually an intuitive application of the simplex algorithm for linear programs. Carefully consider each step in our analysis:

[5] We have only shown here that the solution is a local minimum and not necessarily a global minimum. However, for the linear programing formulation, this minimum solution can be shown to be global also.



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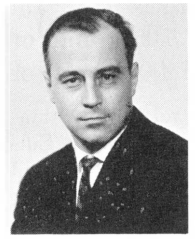

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A single formula cannot keep all elements in proper perspective at all times. . .

1. We assumed internal production of total demand requirements for both products. This required overtime in both departments. That is, of our six decision variables four are positive, i.e., production of both products and overtime in both departments, and two are zero, i.e., the purchase levels for both products. Refer to Tables 1 and 2. In the terminology of linear programing, this is a basic solution.[6]
2. We asked if it is less costly to change from this basic solution. In our case the alternatives were to buy one (or more) unit(s) of either Product 1 or Product 2. In either case, this permitted the firm to make one unit less of either Product 1 or Product 2, respectively. The evaluation was to consider the manufacturing cost of each product (at the current basis) and compare it with the purchase cost. For Product 2, the internal manufacturing cost was $13.10 (refer to Table 3), and the purchase price was $12.00 per unit. Thus, it was less costly to buy one unit of Product 2 and make one unit less. Our procedure is equivalent to the optimality test of the simplex method.[7]
3. Now we want to know how many units of Product 2 should be purchased. So long as overtime is required in both departments (i.e., the basic solution above), it would be less costly to buy an additional unit of Product 2 and manufacture one unit less. We must, therefore, determine the number of units to be bought in order to eliminate overtime in both departments. In Table 6, we found that it was necessary to buy 3,667 units of Product 2 before overtime was eliminated in the first department. (Overtime is still required in Department 2.) We have now found another basic solution. (Note that we still have four positive variable values for our six variables.) In linear programing terminology, we found an adjacent basic feasible solution to the problem. This new basic solution called for:

Make:	Product 1	5,000 units
	Product 2	333 units
Buy:	Product 2	3,667 units
Overtime:		
	Department 2	747 hours

4. With this basic solution, we try to find a less costly solution. No simplex evaluation indicates a decrease in costs. E.g., to buy Product 1 costs $18 per unit, and the internal manufacture cost is $14.60 per unit. (Refer to Table 4.) Thus, it is not profitable to buy any of Product 1. We have found the optimal solution of our problem.

Formalized linear program

Previously, we indicated that there are six decision variables for this illustrative problem and four constraints. The variables are as follows:

- X_1 The amount of internal production of Product 1
- X_2 The amount of internal production of Product 2
- O_1 The amount of overtime in Department 1
- O_2 The amount of overtime in Department 2
- Y_1 The amount of Product 1 bought externally.
- Y_2 The amount of Product 2 bought externally.

The four constraints (stated in terms of the variables) are:

Demand Requirement Constraint:

$$X_1 + Y_1 \geq 5{,}000$$
$$X_2 + Y_2 \geq 4{,}000$$

The first constraint says that the amount made of Product 1 plus the amount bought must be at least equal to the amount required. A similar statement is appropriate for the second constraint for Product 2.

Production Constraints:

$$.1\,X_1 + .3\,X_2 \leq 600 + O_1$$
$$.2\,X_1 + .2\,X_2 \leq 320 + O_2$$

The first production constraint says that for Department 1 the production of X_1 and X_2 made must not require more than the time available on regular time (600 machine hours) plus the amount on overtime (O_1 machine hours).

Specifically, each unit of Product 1 uses .1 machine hours in Department 1, and Product 2 uses .3 machine hours per unit. A similar statement is appropriate for the second production constraint for Department 2. The above statements constitute a complete statement of the constraints for the problem. Now we consider an objective function.

Our goal is to minimize total cost. Each of the six decision variables has an associated variable cost per unit of measure. Namely,

[6] A basic solution is defined as one which contains as many nonzero variable values as there are constraints. See for example: W. J. Baumol, *Economic Theory & Operations Analysis*, Prentice-Hall, Inc., Englewood Cliffs, N. J., 1963, pp. 73 and 77. In this problem, there are four constraints: two production constraints, i.e., one for each department, and two demand requirements, i.e., one for each four variables with a positive level.

[7] *Ibid.*, p. 78.

the variable costs for X_1 and X_2 are the raw material cost of \$10.00 and \$5.00 per unit, respectively; the variable overtime costs for O_1 of \$15.00 and O_2 of \$18.00; and finally, the purchase costs for Y_1 and Y_2 at \$18.00 and \$12.00 per unit, respectively. Thus the objective function becomes:

Minimize $10X_1 + 3X_2 + 18Y_1 + 12Y_2 + 15O_1 + 18O_2$, the cost equation for our problem.[8]

Of course, we require:

$X_1 \geq 0$, $X_2 \geq 0$, $O_1 \geq 0$, $O_2 \geq 0$, $Y_1 \geq 0$, $Y_2 \geq 0$.

One advantage in formulating the problem as a linear program is that we can simply state what is feasible (i.e., what is possible in terms of our production constraints in algebraic terms). Also, we can state in algebraic terms our demand requirements. These two sets of algebraic statements together state what is possible and what is required. Then, we state our objective, here to minimize the total cost of overtime, purchases, and materials. Once the linear program is stated, it is a mechanical process to find a solution for the linear program. This solution process is referred to as the simplex method (or simplex algorithm).

Once the linear program is started, it is a mechanical process to find a solution . . . this method could just as easily handle the problem with twenty products and thirty departments.

Although it is beyond the scope of this article to describe the simplex method in detail, it should be mentioned that the simplex method is discussed in very lucid terms by Baumol in his *Economic Theory and Operations Analysis*.[9] Also, there are numerous other introductory texts in operations research, mathematics for business applications, and modern accounting which develop the technique in straightforward terms. For purposes of this article, it is sufficient to indicate that the simplex method is a general technique for solving a linear objective function with an arbitrary number of variables subject to an arbitrary number of linear constraints. That is, the simplex method is not dependent upon the size of the problem. For example, the simplex method could just as easily handle the problem with twenty products and thirty departments as the problem discussed in this paper. However, this is not true of the cost accounting approach.

Consider again the cost accounting approach to the problem. For two departments and two products, there were only a few possible solutions to the problem, namely, (1) make all of both products and incur overtime in both departments; (2) buy some of one product (both products were considered in turn) and make the rest of this product and all of the other product internally, thus incurring overtime in only one department; and, (3) buy some of both products and make the remaining amount required of both products internally, incurring no overtime.

We carefully (and laboriously) considered, one by one, all of these possibilities and chose the best alternative.

All solutions unnecessary

For the linear programing formulation, we do not have to enumerate all the possible solutions, the simplex method selects the best solution without requiring us to think about all the possible solutions. That is, once we have the formulation as a linear program, the simplex method is a systematic method to select the best solution of all the feasible solutions. In our cost accounting approach we could easily overlook one of the possibilities, and it might be the best one. The possibility of overlooking a possible solution for our small problem is not serious, but consider the problem with twenty products and thirty departments.

To enumerate all of them would

[8] The objective function stated here does not include the cost of operating both departments on regular time, which is considered fixed in our formulation of the problem. When using the objective function for calculating the total cost of the firm one would have to add \$9,840, the cost of operating the two departments during regular time.

[9] *Ibid.*

be an impossible task. But with the linear programing formulation, we can find a solution in a few minutes with the aid of a digital computer. For the small problem here, the solution was obtained on a relatively slow computer[10] in less than thirty seconds, and this reason is a primary reason for using the linear programing formulation. The optimal solution to the linear program as we formulated the problem is:

$X_1 = 5{,}000$
$X_2 = 333.33$
$Y_1 = 0$
$Y_2 = 3{,}666.67$
$O_1 = 0$
$O_2 = 746.67$

Computer programs for the simplex method are readily available on the market today. Practically all computer manufacturers who will sell you a computer will also sell you a computer program for the simplex method for the particular computer.[11]

The significance of the above discussion is that 1) the cost accounting approach is correct but unworkable for large problems, and, 2) computer programs are readily available to solve linear programing problems. The advantage of the linear programing approach is not that the simplex method is more easily explained than the cost accounting approach but that we can reasonably consider larger problems and solve them by using the digital computer in a reasonable amount of time.

Conclusions

Although not stated explicitly, it is implicit in the foregoing analysis that the linear programing approach to make or buy analysis can be extended to more than two products and more than two departments. Also, if this extension is made, the simplex algorithm can readily provide the optimal solution.

Traditional approach laborious

However, the more complex situation just suggested would create a rather laborious task if the traditional cost accounting approach is undertaken. The multiperiod solution adds a considerable number of variables which can be handled by linear programing but would increase considerably the computational burdens of the cost accounting approach. Likewise, variables in workforce level could be considered where there are trade-offs between hiring workers for many periods and employing these workers on regular time rather than requiring overtime for the present workforce.

In comparing the two approaches to the problem, we should keep in mind that the assumptions for both approaches are the same. Although it is more obvious for the linear programing formulation, both models assume linearity in the production processes and linearity of the cost terms.

Furthermore, both models assume that fixed costs and variable costs are segregated in like manner — namely, the fixed costs involve operations on regular time and the variable costs involve purchasing costs and overtime costs. One advantage of the linear programing formulation is that it is more obvious that we are making these assumptions than it is with the more traditional cost accounting approach.

Throughout this paper we have referred to the firm as the basic organizational unit. However, this type of model is equally applicable (and, perhaps more useful) for a division within a larger decentralized firm.

Not infrequently, a division is given the task of supplying the firm with a given amount (i.e., a demand requirement) of parts or subassemblies which may be made or bought at a minimum total cost.

In comparing the two approaches to the problem, we should keep in mind that the assumptions for both approaches are the same.

[10] The IBM 1620

[11] One example is the MPS program for the IBM 360 computer series.

This article, describing as it does an application worked out on one of the largest and most expensive computers, may be beyond the scope of most in-house EDP facilities. But for those firms dealing with data centers or university computing centers, it offers real possibilities.

A COMPUTER PROGRAMMING APPROACH TO THE DESIGN OF ACCOUNTING SYSTEMS

by R. L. Mathews
Australian National University

DESPITE the key role of accounting in the provision of information for managerial and other purposes, the revolution in data processing that has resulted from the development of the electronic computer has not had the impact on the accounting information system that might reasonably have been expected. To some extent this may have been due to a reluctance on the part of accountants to substitute new and unfamiliar methods of data processing for techniques that have become hallowed by usage and tradition; but such an explanation is difficult to reconcile with the observable fact that accountants, while apparently loath to change the structure of the accounting system, have been exceedingly active in applying the computer to specialized tasks, such as payroll preparation, invoicing, and the recording of stock movements, which form part of the wider accounting process.

The principal reason for the lag in the application of computer technology to the accounting information system would seem to be incompatibility between the form of the double-entry recording system, which it must be remembered has slowly evolved during the last five hundred years or more, and the data processing qualities of the computer. The nature of this incompatibility will be examined in the following paragraphs.

Accounting information system

The task of the accounting system is to provide information about economic transactions as a basis for planning, decision making and control. The information required includes reports of various kinds, which will be used by the persons receiving them to assess performance, initiate action, or facilitate control. The reports may be retrospective or anticipatory; they may deal with long-run or short-run situations; they may be comprehensive or sectional; but in any case they will be derived (if at

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The author records his appreciation to members of the Accounting Division of the Graduate School of Business Administration, University of California, Los Angeles, for their comments on the program which is reproduced in the Appendix to this paper and to Mr. B. W. Smith, of the Australian National University Computer Centre, and members of the University's Department of Accounting and Public Finance for their comments on an earlier draft of the paper.

times rather tenuously) from the accounting system which has been designed for the purpose of providing the information in question. An examination of the accounting information system that has developed in response to these needs indicates that the different aspects of data processing—collection and recording of input, computation, storage of data, control, and the dissemination of output—have come to be handled in a way that permits the fragmentation of the processing operations (albeit within the integrated framework that is provided by the double-entry system).

So far as the input process is concerned, the traditional system is characterized by a multiplicity of data sources, a multi-tiered classification system, a method of recording diverse transactions that has regard to the chronological order in which they occur, and a disaggregated system of ledger accounts which nevertheless reflects the integrating and equilibrating notion of duality of entry. The recording process that has evolved in response to these conditions inevitably results in transactions being dealt with individually rather than in the mass. This in turn means that one account at a time is selected (two accounts in respect to any one transaction) as the repository of transaction data. Some transactions occur frequently enough to make it worthwhile grouping them for purposes of the recording process by means of specialized journals and ledgers. Group treatment of such transactions followed recognition of this.

The mechanization of the recording process encouraged this tendency for data to be processed in runs of similar transactions, just as it facilitated the concurrent preparation of evidence documents (e.g., receipts or invoices), chronological records (i.e., journals), and ledgers. But the structure of the accounting system, as reflected in the ledger, has remained basically unchanged, and the input process continues to be characterized by the piecemeal approach that has been described.

To the extent that computation is carried out within the accounting system, it usually involves only simple arithmetical calculations and the determination of ledger balances. The accounting system has provided for the storage of data in a form which facilitates ready accessibility and easy reference, having regard to the purposes for which the information is likely to be required. Although one of the main functions of the system is that of control, and although some controls are built into the system (e.g., through the use of the control account technique or the derivation of standard cost variances), the controls which are obtained are not automatic and depend essentially on human review.

The reports or financial statements which constitute the output of the accounting system are heterogeneous in character, and are presented on a multiplicity of forms at different time intervals depending on their purpose. An elaborate summarization process is a necessary prerequisite to the preparation of annual financial statements, but the accounting system is not always designed in such a way as to provide, at least without painstaking analysis outside the formal structure of accounts, information of significance to management (e.g., with respect to cost behaviour in relation to volume) or proprietors (e.g., with respect to current values).

The computer

If the foregoing characteristics of the traditional accounting system are considered in relation to the qualities of the computer with respect to each of its main functions, a number of interesting problems can be seen to exist. So far as input is concerned, effective utilization of the computer demands the feeding in of data as far as possible in homogeneous runs and preferably as a by-product of other operations. The heterogeneous nature of business transactions and the selective method of recording them in the accounting system will produce an input bottleneck of such proportions as to invalidate the use of the computer unless special action is taken to deal with these problems. Such action includes, insofar as specialized accounting applications are concerned, the following:

(a) changes in system design, involving for example the organization of data in runs of transactions of similar accounting significance, e.g., stock purchases, credit sales, cash receipts;

(b) steps to obtain maximum advantage from computer facilities, involving, for example, the use of input media which give direct or "on-line" access to the computer at the time the transaction is first recorded and/or which produce punched cards or tapes either simultaneously with the preparation of conventional employee time cards, invoices, receipts, production reports, etc., or automatically from mark-sensed data.

Despite substantial progress in both these directions, however, complete computerization of input has been retarded by the failure of accountants to modify the design of the basic accounting system as reflected in the double-entry framework of ledger accounts.

Turning now to computation, it is a feature of modern computers that they can handle both complex mathematical problems and repetitive processing combined with simple arithmetical calculations. The first characteristic is not of much significance in relation to accounting, although it does assume importance for purposes of other business applications in the decision-making area. The second characteristic is of fundamental importance for purposes of accounting.

Data storage is not inherently a problem in computer applications because of the possibility of utilizing both the computer's own core storage and external media such as punched cards and magnetic tapes. In practice it becomes a problem

in relation to accounting operations because of the need for continuous updating of, and ready access to, stored data. A partial solution to this problem has been found in the use of random access methods of storage, involving, for example, the use of magnetic disks, rather like gramophone records in a juke box, to store accounting data. Individual accounts or items can be selected and updated, thus avoiding the need to search sequentially through the complete tape or deck of cards. But while magnetic disks make it possible to obtain random access to accounts of similar significance, e.g., accounts receivable, cost records, etc., they do not easily provide random access of the two-dimensional kind which would be necessary for purposes of updating a complete set of double-entry accounts.

There is another feature of the computer, or more specifically of computer programing languages, which seems to have been seldom exploited for accounting purposes, but which we shall see has considerable potential with respect to the storage and processing of accounting data. This is the ability of the computer to store and process data in the form of two-dimensional or three-dimensional arrays.

In a computer system, control of data processing operations is achieved by means of a central processing unit which automatically arranges for the execution of the various functions that need to be performed, from input through to final output. This control is achieved by means of instructions which are given to the computer in the form of a stored program. In addition to ensuring automatic control of data as they are manipulated or transferred from one operation or function to another, the stored program can be made to incorporate accounting control in respect of managerial performance, such as is involved in the use of control accounts of standard cost variances. By programing the computer to print error messages or report on variances, the information necessary to achieve such control is provided automatically.

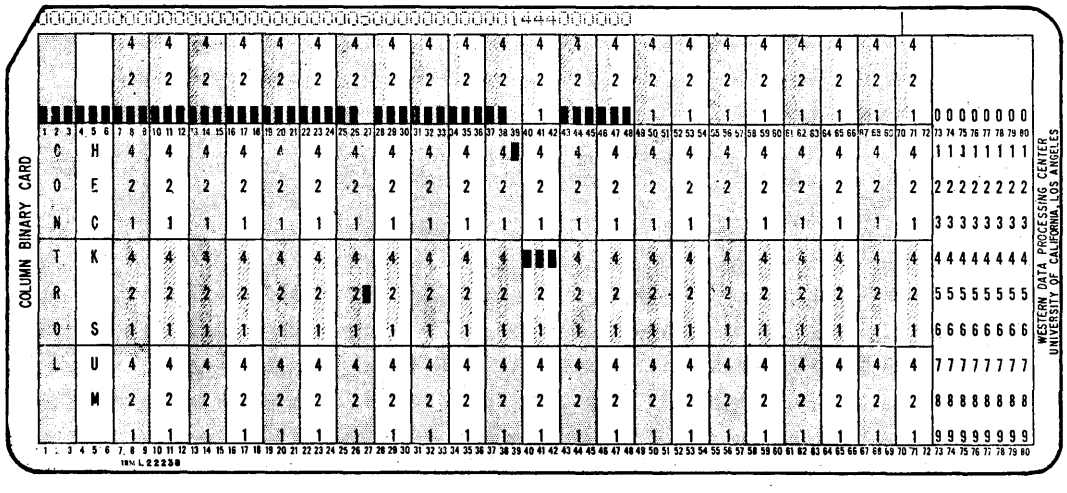
Finally, given the input and the instructions which are contained in the program, the computer will print its output automatically. It may thus be programed in such a way as to carry out without human intervention the elaborate summarization process which is needed to convert transaction data into financial statements such as income statements or balance sheets. There is a problem here, however, which depends for its solution on finding a method of recording all accounting transactions in a system that is compatible both with duality in the accounting record and with the integration of computer processing operations. As we shall see, this in turn requires modifications in the design of the accounting system.

Redesigning the system

Having regard to these qualities of the computer, it is not surprising that accounting applications have usually been restricted to areas where the input, storage, and accessibility problems that have been discussed may be minimized and where the repetitive processing, computational, control, and output features may be used to the fullest extent possible. Such applications include payroll, stocks, accounts receivable, accounts payable, cash receipts, cash payments, but do not typically extend to the complete accounting system. Because of the input and storage features which have been noted, it is difficult to program the computer to record ledger entries in the traditional way. So long as the accounting system is designed to contain a multiplicity of ledger accounts recording a wide range of transactions, programing is likely to be restricted to partial applications and the ac-

FIGURE 1

A COMPUTER PROGRAMMING APPROACH TO ACCOUNTING



counting system will not be fully converted to computer operations. Although data may be organized in batches of similar transactions for computer processing, the large variety of transactions inhibits a global or total approach to the computerization of the accounting system, at least so long as the traditional form of the accounting system is retained.

Accountants have recognized the importance of systems analysis and design in relation to computer applications, but so far their work in this area has been mainly restricted to the partial applications which have been listed. They have been slower to recognize the need for a critical examination of the accounting system considered as a whole, involving among other things a review of the traditional basis of recording transactions in ledger accounts. But while it is difficult for the computer to record transactions in this way, there is a particular feature of the computer which suggests the possibility of an alternative solution to the problem, one which continues to record transactions on the basis of a duality concept but which relies on the recording of each transaction by means of a single entry in a matrix system instead of a double entry in a system of disaggregated accounts. This is the computer's ability, which we have noted, to store and process data in terms of two- (or three-) dimensional arrays or tables, that is to say in matrix form.

Matrix accounting

The idea of recording accounting data in a matrix system is not a new one. In business accounting the notion of a "spread sheet" incorporates a matrix approach to the recording of transactions,[1] and the spread sheet has recently been used to illustrate the possibility of applying mathematical optimizing techniques to the task of budgetary planning.[2] Other writers have used the term "double classification bookkeeping" to describe a matrix approach to accounting which they suggested could be adapted to punched card equipment or computers.[3] In national accounting the matrix approach has an even longer tradition, culminating in input-output accounting.[4]

A computer program

In writing a computer program, the programer should proceed logically through the stages of defining the information requirements and deciding on the form of the output before he reviews the input data and determines the processing and control requirements. For purposes of this paper it will be assumed that the information and output requirements are the same as in a conventional accounting system, except to the extent that a ledger matrix is substituted for a system of double entry accounts.

If the accounting system is designed in matrix form, the computer may be programed to set aside a number of fields corresponding to the cells in the matrix. In the Fortran IV programing language this may be done by means of what is known as a dimension statement. The statement

```
DIMENSION KASYS (11, 8)
```

thus instructs the Fortran processor to make provision for a table containing eleven rows and eight columns, or eighty-eight cells. We may think of KASYS as a code representing the accounting system in matrix form.

A second dimension statement

```
DIMENSION IASYS (11, 8)
```

together with an instruction to read in transaction data from the data cards

```
READ (5, 1) ((IASYS (I, J),
J = 1, 8), I = 1, 11)
```

enables the input to be posted to a holding matrix, the data in which are automatically transferred to an accumulating matrix by means of the instruction

```
KASYS (I, J) = KASYS (I, J)
+ IASYS (I, J)
```

(the accumulating matrix will have been cleared previously, i.e., each cell given the value of zero, by means of the instruction KASYS (I, J) = 0).

A READ statement instructs the computer to read data into the matrix from cards that have been punched in accordance with a prescribed FORMAT statement. If, as in Appendix D, the FORMAT statement takes the following form

```
1 FORMAT (8 I 6)
```

this means that, to conform with FORMAT statement no. 1, cards must be punched with eight fields each of six values representing digits or signs. The eight fields in each card may be identified with the eight columns in the matrix that has been established. The eighth column, representing total debits, should be punched with

[1] See Eric L. Kohler, *A Dictionary for Accountants*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1952.

[2] See A. Charnes, W. W. Cooper, and Y. Ijiri, "Breakeven Budgeting and Programming to Goals," *Journal of Accounting Research*, Spring, 1963, p. 16. See also Y. Ijiri, F. K. Levy, and R. C. Lyon, "A Linear Programming Model for Budgeting and Financial Planning," *Journal of Accounting Research*, Autumn, 1963, p. 198.

[3] J. G. Kemeny, A. Schleifer, J. L. Snell, and G. L. Thompson, *Finite Mathematics with Business Applications*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1962, pp. 346-351, 358-362.

[4] The earliest presentation of national accounts in tabular form was undertaken by F. Quesnay in his *Tableau Economique*, while W. Leontief was responsible for the development of a formal system of input-output accounting in his book *The Structure of the American Economy 1919-1939*, Oxford University Press, 1941. See also. Russell Mathews, "Business Enterprise Accounts in Relation to Different Kinds of Social Accounting Systems," *The Economic Record*, March, 1960, p. 95 Richard Mattessich, in "Towards an Axiomatization of Accountancy, with an Introduction to the Matrix Formulation of Accounting Systems," *Accounting Research*, October, 1957, p. 328, and *Accounting and Analytical Methods*, Richard D. Irwin, Inc., Homewood, Illinois, 1964, applies the matrix approach to the development of both business and national accounting systems.

FIGURE 2

```
OFORMAT(1H1,28X,13HLEDGER MATRIX/,7X,48H  CASH INVEN ACDEP ACPAY JS
1CAP JSCUR SALES TOTDR/,7H CASH  ,816/,7H ACREC ,816/,7H INVEN ,816
2/,7H FIXED ,816/,7H COFGS ,816/,7H RENT  ,816/,7H WAGES ,816/,7H D
3EPRC ,816/,7H OTHEX ,816/,7H JSDWG ,816/,7H TOTCR ,816)

WRITE(6,4)((KASYS(I,J),J=1,8),I=1,11)
```

zeros because the computer will be programed to calculate the totals automatically. If eleven cards are punched representing the eleven rows in the matrix, the READ statement

READ (5, 1) ((IASYS (I, J), J = 1, 8), I = 1, 11)

will ensure that the cards are read in the order of the rows and that the data contained therein are assigned to their appropriate cells. The eleventh card, representing total credits, should be punched with zeros in all eight fields because the program will arrange for the totals to be calculated automatically.

The first week's transactions for the hypothetical business of J. Smith are reproduced in Appendix A on page 40, and a data card is illustrated in Figure 1 on page 34.

It is necessary to comment briefly on the way in which transaction data are accumulated prior to the punching of the cards. In a fully computerized system it is possible to conceive of data being fed into the matrix direct from input media, which simultaneously produce the documents that provide evidence of the transactions. However, in the system that is described in this paper the different groups of transactions are recorded initially in a system of specialized journals (see Appendix B, page 40). Separate computer programs could be written to record these transactions and produce the transaction data needed as input for the main program. Specialized operations such as payrolls could be dealt with in the same way. On the basis of the information contained in these originating records, weekly transaction tables (or if desired daily tables) may be prepared for the general ledger matrix and the two subsidiary ledgers (see Appendix C, page 41). The data cards to be processed in the main system will then be punched, one card for each row, in accordance with the transaction tables.

After the posting is complete (and several sets of cards may be posted in this way), the computer may be programed to print out the data contained in the ledger matrix by means of another FORMAT statement, which specifies the form of the output, and a WRITE statement (see Figure 2, this page).

On the basis of the first week's transactions listed in Appendix A, these instructions would result in a print-out of the ledger in matrix form as reproduced in Figure 3 below on this page.

The ledger matrix has been designed in such a way as to assign rows to accounts receiving what would traditionally be recorded as debit entries and columns to accounts receiving credit entries. Codes have been used for account names as follows:

CASH	Bank
ACREC	Accounts Receivable
INVEN	Inventories
FIXED	Fixed Assets
COFGS	Cost of Goods Sold
DEPRC	Depreciation
OTHEX	Other Expenses
JSDWG	J. Smith Drawings A/c
TOTCR	Total Credits
ACDEP	Accumulated Depreciation
ACPAY	Accounts Payable
JSCAP	J. Smith Capital A/c
JSCUR	J. Smith Current A/c
TOTDR	Total Debits

It will be seen that the first transaction, the bank deposit of $5,000 by J. Smith representing his capital contribution to the business, has been recorded as an entry in the cell corresponding to the CASH

FIGURE 3

LEDGER MATRIX

	CASH	INVEN	ACDEP	ACPAY	JSCAP	JSCUR	SALES	TOTDR
CASH	0	0	0	0	5000	0	1444	6444
ACREC	0	0	0	0	0	0	621	621
INVEN	0	0	0	4064	0	0	0	4064
FIXED	1200	0	0	0	0	0	0	1200
COFGS	0	1246	0	0	0	0	0	1246
RENT	200	0	0	0	0	0	0	200
WAGES	190	0	0	0	0	0	0	190
DEPRC	0	0	0	0	0	0	0	0
OTHEX	0	0	0	0	0	0	0	0
JSDWG	60	0	0	0	0	0	0	60
TOTCR	1650	1246	0	4064	5000	0	2065	14025

FIGURE 4

AC RECEIVABLE
WEEK 1

	BEGBAL	DR 1	DR 2	DR 3	CR	ENDBAL
C.CARTER	0	45	15	0	0	60
J.JACKSON	0	85	40	94	0	219
N.NORTON	0	95	43	0	0	138
P.PARKER	0	20	0	0	0	20
R.ROYCE	0	0	0	0	0	0
W.WILLIAMS	0	40	95	49	0	184
TOTAL	0	285	193	143	0	621

AC PAYABLE
WEEK 1

	BEGBAL	DR	CR	ENDBAL
B.BARKER	0	0	575	575
G.GRACE	0	0	568	568
H.HOWARD	0	0	561	561
M.MOSS	0	0	1020	1020
S.STEWART	0	0	740	740
T.THOMPSON	0	0	600	600
TOTAL	0	0	4064	4064

row and the JSCAP column; similarly with the other transactions. Some accounts, such as CASH and INVEN, which traditionally receive both debit and credit entries that are offset in other accounts in the system, are represented in both the rows and the columns of the matrix. It is not necessary to include all accounts in both columns and rows, since some accounts do not record transactions involving both debit and credit entries.

Negative entries may be made in cells where accounts normally receiving debit entries need to record credit entries; thus cash received from debtors may be recorded as a negative item in the cell formed by the ACREC row and the CASH column.

The program which is illustrated

FIGURE 5

TRIAL BALANCE
WEEK 1

	DR	CR
CASH	4794	
ACREC	621	
INVEN	2818	
FIXED	1200	
COFGS	1246	
RENT	200	
WAGES	190	
DEPRC	0	
OTHEX	0	
JSDWG	60	
ACDEP		0
ACPAY		4064
JSCAP		5000
JSCUR		0
SALES		2065
TOTAL	11129	11129

merely records accumulated entries in each cell. In practice, complete records of transactions affecting each account are likely to be required. These could be obtained either by preparing a new ledger matrix each day and aggregating the results by means of a separate program or by adding a third dimension to the table to provide information about the date of each transaction and to give opening and closing balances. The computer can easily be programed to hold three-dimensional tables. It is not necessary to include summary accounts, e.g., trading and profit and loss or income accounts, in the ledger matrix; separate instructions are included in the program to print out, at appropriate intervals, a trial balance, an income statement, and a balance sheet on the basis of account balances derived from the ledger matrix.

The balances of accounts which include only debit or credit entries are given by the totals of the rows and columns, respectively; the computer is programed to calculate these balances, and a further instruction defines them by reference to their respective cell locations. For example

$$KACREC = KASYS\ (2, 8)$$

indicates where the balance of Accounts Receivable Account is to be found when it is needed for reference or further processing (namely the cell formed by row 2 and column 8).

The balance of an account which appears in both a row and a column is obtained by extending the instructions so as to define the balance as the difference between total debits and total credits, as follows:

$$KCASHB = KCASHD - KCASHC$$

where KCASHD has previously been defined as the sum of the debits to Cash Account, as recorded in cell 1, 8 of the ledger matrix and KCASHC has been defined as the sum of the credits in cell 11, 1.

Individual accounts

In the program illustrated in Appendix D on page 42, separate DIMENSION, FORMAT, READ, and WRITE instructions have been included in respect to individual accounts receivable and accounts payable, which thus constitute subsidiary ledgers controlled in the usual way by control accounts in the general ledger. Separate data cards are then provided for accounts receivable and accounts payable. Each debtor's or creditor's account has been designed to record the balance at the beginning of each week, a sufficient number of debit and credit entries (these may be extended as necessary, for example, to provide for separate entries for each day of the week), and the balance at the end of the week (see Figure 4 above). The program could easily be generalized to provide for additional accounts receivable or accounts payable.

At the end of the week a trial balance is automatically printed out in accordance with programed instructions which specify the format of the trial balance, define the items which are recorded in it, and arrange for the calculation of the total debits and total credits (see Figure 5, this page).

The computer is programed to compare the total debits and the total credits in the trial balance

The complete program, illustrated in Appendix D, could easily be extended....

and to print out an error message if the totals do not agree. Further instructions ensure that the balances in the accounts receivable and accounts payable accounts are compared with the sums of the balances in the accounts receivable and accounts payable ledgers (see Figure 4), error messages being printed out if the respective amounts do not agree. Since the ledger matrix for the general ledger and the matrices for the two subsidiary ledgers have been posted from different sets of data cards, this provides a built-in control over the subsidiary ledgers in a manner that is analogous to the control achieved in a conventional accounting system. The program could easily be extended to provide for other subsidiary ledgers.

The program which is illustrated in Appendix D provides for the insertion of a separate data card with each week's transactions to indicate the number of the week (in practice separate data cards would probably be inserted with each day's transactions). At the end of each week, as we have seen, the program provides for a print-out of the trial balance and the subsidiary ledger matrices (this could be done on a daily basis if desired), but the program also provides for the preparation of an income statement and balance sheet at the end of each four weeks' transactions. An additional control statement ensures the accuracy of the program in relation to this task. The print-out in respect of Week 4 is illustrated in Figure 6 below.

The complete program is illustrated in Appendix D. It could easily be extended to provide for a more elaborate accounting system. It was written by the author and run on an IBM 7094 computer at the Western Data Processing Center, Graduate School of Business Administration, University of California, Los Angeles, in December, 1966.

It has been argued in this paper that effective utilization of the computer in accounting applications requires thought to be given, not only to the analysis and design of business systems in relation to particular data processing operations which form part of the accounting function, but also to the design of the accounting system itself. In particular, it is suggested that, for purposes of computer programing, a ledger in matrix form needs to be substituted for the traditional double-entry framework of ledger accounts. A ledger matrix offers scope for the development of a computer program which minimizes the input and storage difficulties which are associated with disaggregated data sources, while permitting maximum use to be made of the computer's qualities with respect to computation, repetitive data processing, automatic control, and the printing of all output.

FIGURE 6

LEDGER MATRIX

	CASH	INVEN	ACDEP	ACPAY	JSCAP	JSCUR	SALES	TOTDR
CASH	0	0	0	-1563	5000	0	3546	6983
ACREC	-185	0	0	0	0	0	3377	3192
INVEN	0	0	0	6467	0	0	0	6467
FIXED	1200	0	0	0	0	0	0	1200
COFGS	0	4426	0	0	0	0	0	4426
RENT	200	0	0	0	0	0	0	200
WAGES	760	0	0	0	0	0	0	760
DEPRC	0	0	10	0	0	0	0	10
OTHEX	126	0	0	0	0	0	0	126
JSDWG	186	0	0	0	0	0	0	186
TOTCR	2287	4426	10	4904	5000	0	6923	23550

TRIAL BALANCE
WEEK 4

	DR	CR
CASH	4696	
ACREC	3192	
INVEN	2041	
FIXED	1200	
COFGS	4426	
RENT	200	
WAGES	760	
DEPRC	10	
OTHEX	126	
JSDWG	186	
ACDEP		10
ACPAY		4904
JSCAP		5000
JSCUR		0
SALES		6923
TOTAL	16837	16837

INCOME STATEMENT
WEEK 4

SALES		6923
COFGS		4426
GROSP		2497
RENT	200	
WAGES	760	
DEPRC	10	
OTHEX	126	
TOTEX		1096
NETPR		1401

BALANCE SHEET
WEEK 4

ASSETS		
CASH		4696
ACREC		3192
INVEN		2041
FIXED	1200	
ACDEP	10	
NETFIX		1190
TOTASS		11119
ACPAY		4904
JSCAP	5000	
JSCUR	1215	
OWNEQ		6215

AC RECEIVABLE
WEEK 4

	BEGBAL	DR 1	DR 2	DR 3	CR	ENDBAL
C.CARTER	151	49	48	0	-60	188
J.JACKSON	580	104	0	0	-125	559
N.NORTON	679	140	0	0	0	819
P.PARKER	243	34	0	0	0	277
R.ROYCE	248	68	148	0	0	464
W.WILLIAMS	595	86	204	0	0	885
TOTAL	2496	481	400	0	-185	3192

AC PAYABLE
WEEK 4

	BEGBAL	DR	CR	ENDBAL
B.BARKER	903	-575	41	369
G.GRACE	781	-568	143	356
H.HOWARD	929	-420	0	509
M.MOSS	1382	0	202	1584
S.STEWART	824	0	92	916
T.THOMPSON	1170	0	0	1170
TOTAL	5989	-1563	478	4904

APPENDIX A

Transactions — First Week

19—			
Feb. 1	Deposited $5,000 capital in bank		
	Paid January rent $200		
	Purchased shop fittings $1,200 for cash		
2	Purchased trading inventories as follows (credit purchases):		
	T. Thompson	$600	
	S. Stewart	450	
	B. Barker	575	
	G. Grace	365	
	H. Howard	420	
	M. Moss	785	$3,195
	Credit sales (cost of goods sold $195):		
	J. Jackson	$ 85	
	P. Parker	20	
	W. Williams	40	
	N. Norton	95	
	C. Carter	45	$ 285
	Cash sales (cost $590):		$1,100
3	Credit sales (cost $106):		
	J. Jackson	$ 40	
	C. Carter	15	
	W. Williams	95	$ 150
	Cash sales (cost $100):		$ 140
4	Credit purchases:		
	M. Moss	$283	
	G. Grace	203	
	H. Howard	141	
	S. Stewart	290	$ 917
	Cash sales (cost $141):		$ 204
Feb. 5	Credit sales (cost $114):		
	J. Jackson	$ 94	
	N. Norton	43	
	W. Williams	49	$ 186
	Purchase returns — M. Moss $48		
	Wages paid		$ 190
	Proprietor's drawings		$ 60

APPENDIX B

Journals — First Week

Cash Receipts Journal

19—	*Particulars*	*Computer posting*	*Accounts rec.* IASYS —(2, 1)	*Cash sales* IASYS (1, 7)	*Other receipts* —	*Total* —	*Bank* —
Feb. 1	J. Smith	IASYS(1, 5)			5,000	5,000	5,000
2	Sales			1,100		1,100	1,100
3	Sales			140		140	140
4	Sales			204		204	204
5	Total		—	1,444	5,000	6,444	6,444

Cash Payments Journal

19—	*Particulars*	*Computer posting*	*Accounts payable* IASYS —(1, 4)	*Invent.* IASYS (3, 1)	*Fixed assets* IASYS (4, 1)	*Rent* IASYS (6, 1)	*Wages* ISAYS (7, 1)	*Other exp.* IASYS (9, 1)	*J. Smith draw.* IASYS (10, 1)	*Total* —	*Bank* —
Feb. 1	Rent					200				200	200
	Fixed assets				1,200					1,200	1,200
5	Wages						190			190	
	J. Smith drawings								60	60	250
	Total				1,200	200	190		60	1,650	1,650

Credit Sales Journal

19—	Particulars	Computer posting		Amount
Feb. 2	J. Jackson	IREC	(2,2)	85
	P. Parker	IREC	(4,2)	20
	W. Williams	IREC	(6,2)	40
	N. Norton	IREC	(3,2)	95
	C. Carter	IREC	(1,2)	45
3	J. Jackson	IREC	(2,3)	40
	C. Carter	IREC	(1,3)	15
	W. Williams	IREC	(6,3)	95
5	J. Jackson	IREC	(2,4)	94
	N. Norton	IREC	(3,3)	43
	W. Williams	IREC	(6,4)	49
	Total	IASYS	(2,7)	621

Cost of Goods Sold Journal

19—	Particulars	Computer posting		Amount
Feb. 2	Credit Sales			195
	Cash Sales			590
3	Credit Sales			106
	Cash Sales			100
4	Cash Sales			141
5	Credit Sales			114
	Total	IASYS	(5,2)	1,246

Credit Purchases Journal

19—	Particulars	Computer posting		Amount
Feb. 2	T. Thompson	IPAY	(6,3)	600
	S. Stewart	IPAY	(5,3)	450
	B. Barker	IPAY	(1,3)	575
	G. Grace	IPAY	(2,3)	365
	H. Howard	IPAY	(3,3)	420
	M. Moss	IPAY	(4,3)	785
4	M. Moss	IPAY	(4,3)	283
	G. Grace	IPAY	(2,3)	203
	H. Howard	IPAY	(3,3)	141
	S. Stewart	IPAY	(5,3)	290
5	M. Moss	IPAY	—(4,3)	—48
	Total	IASYS	(3,4)	4,064

General Journal
No Transactions in First Week

APPENDIX C

Transaction Tables First Week

IASYS	1	2	3	4	5	6	7	8
1					5,000		1,444	
2							621	
3				4,064				
4	1,200							
5		1,246						
6	200							
7	190							
8								
9								
10	60							

IREC	1	2	3	4	5	6
1		45	15			
2		85	40	94		
3		95	43			
4		20				
5						
6		40	95	49		

IPAY	1	2	3	4
1			575	
2			568	
3			561	
4			1,020	
5			740	
6			600	

Computer Program for Accounting System with General Ledger and Two Subsidiary Ledgers

APPENDIX D

COMPUTER PROGRAM FOR ACCOUNTING SYSTEM WITH GENERAL LEDGER AND TWO SUBSIDIARY LEDGERS

```
C FORTRAN IV PROGRAM FOR ACCOUNTING SYSTEM WITH GENERAL LEDGER AND TWO
C SUBSIDIARY LEDGERS IN MATRIX FORM
C DIMENSIONS OF MATRICES USED FOR POSTING GENERAL LEDGER(IASYS),STORING
C GENERAL LEDGER(KASYS),ACCOUNTS RECEIVABLE LEDGER(IREC) AND ACCOUNTS
C PAYABLE LEDGER(IPAY)
      DIMENSION IASYS(11,8),KASYS(11,8),IREC(7,6),IPAY(7,4)
C INPUT FORMATS FOR GENERAL LEDGER,ACCOUNTS RECEIVABLE AND ACCOUNTS
C PAYABLE LEDGERS
1     FORMAT(8I6)
2     FORMAT(6I6)
3     FORMAT(4I6)
C OUTPUT FORMAT FOR GENERAL LEDGER MATRIX
4     OFORMAT(1H1,28X,13HLEDGER MATRIX/,7X,48H  CASH INVEN ACDEP ACPAY JS
     1CAP JSCUR SALES TOTDR/,7H CASH  ,8I6/,7H ACREC ,8I6/,7H INVEN ,8I6
     2/,7H FIXED ,8I6/,7H COFGS ,8I6/,7H RENT  ,8I6/,7H WAGES ,8I6/,7H D
     3EPRC ,8I6/,7H OTHEX ,8I6/,7H JSDWG ,8I6/,7H TOTCR ,8I6)
C INPUT FORMAT TO IDENTIFY WEEK NUMBER
5     FORMAT(I2)
C OUTPUT FORMATS FOR TRIAL BALANCE,INCOME STATEMENT,BALANCE SHEET,ERROR
C MESSAGES,ACCOUNTS RECEIVABLE AND ACCOUNTS PAYABLE SCHEDULES
6     OFORMAT(1H1,7X,13HTRIAL BALANCE/,11X,5HWEEK ,I2/,10X,2HDR,5X,2HCR/,
     17H CASH  ,I6/,7H ACREC ,I6/,7H INVEN ,I6/,7H FIXED ,I6/,7H COFGS ,
     2I6/,7H RENT  ,I6/,7H WAGES ,I6/,7H DEPRC ,I6/,7H OTHEX ,I6/,7H JSD
     3WG ,I6/,7H ACDEP ,7X,I6/,7H ACPAY ,7X,I6/,7H JSCAP ,7X,I6/,7H JSCU
     4R ,7X,I6/,7H SALES ,7X,I6/,7H TOTAL ,I6,1X,I6)
7     OFORMAT(1H1,7X,16HINCOME STATEMENT/,11X,5HWEEK ,I2/,7H SALES ,8X,I6
     1/,7H COFGS ,8X,I6/,7H GROSP ,8X,I6/,7H RENT  ,2X,I6/,7H WAGES ,2X,
     2I6/,7H DEPRC ,2X,I6/,7H OTHEX ,2X,I6/,7H TOTEX ,8X,I6/,7H NETPR ,8
     3X,I6)
8     OFORMAT(1H ,9X,13HBALANCE SHEET/,11X,5HWEEK ,I2/,7H ASSETS/,7H CASH
     1  ,8X,I6/,7H ACREC ,8X,I6/,7H INVEN ,8X,I6/,7H FIXED ,2X,I6/,7H AC
     2DEP ,2X,I6/,7H NETFIX,8X,I6/,7H TOTASS,8X,I6/,7H ACPAY ,8X,I6/,7H
     3JSCAP ,2X,I6/,7H JSCUR ,2X,I6/,7H OWNEQ ,8X,I6)
9     FORMAT(1H1,19HTRIAL BALANCE ERROR)

10    FORMAT(1H1,19HBALANCE SHEET ERROR)
11    OFORMAT(1H1,17X,13HAC RECEIVABLE/,18X,5HWEEK ,I2/,11X,36HBEGBAL  DR
     1 1  DR 2  DR 3   CR ENDBAL/,11H C.CARTER  ,6I6/,11H J.JACKSON ,6I6
     2/,11H N.NORTON  ,6I6/,11H P.PARKER  ,6I6/,11H R.ROYCE   ,6I6/,11H
     3W.WILLIAMS,6I6/,11H TOTAL     ,6I6)
12    OFORMAT(1H1,16X,10HAC PAYABLE/,17X,5HWEEK ,I2/,11X,24HBEGBAL   DR
     1  CR ENDBAL/,11H B.BARKER  ,4I6/,11H G.GRACE   ,4I6/,11H H.HOWARD
     2 ,4I6/,11H M.MOSS    ,4I6/,11H S.STEWART ,4I6/,11H T.THOMPSON,4I6/
     3,11H TOTAL     ,4I6)
13    FORMAT(1H1,24HRECEIVABLE CONTROL ERROR)
14    FORMAT(1H1,21HPAYABLE CONTROL ERROR)
C CLEARING,POSTING AND ACCUMULATING INSTRUCTIONS
15    FORMAT(I1)
      DO50J=1,8
      DO50I=1,11
      KASYS(I,J)=0
50    CONTINUE
      DO51J=1,6
      DO51I=1,7
      IREC(I,J)=0
51    CONTINUE
      DO52J=1,4
      DO52I=1,7
      IPAY(I,J)=0
52    CONTINUE
      READ(5,15)N



      DO25K=1,N
      READ(5,1)((IASYS(I,J),J=1,8),I=1,11)
      DO26I=1,11
      DO26J=1,8
      KASYS(I,J)=KASYS(I,J)+IASYS(I,J)
26    CONTINUE
25    CONTINUE
      READ(5,2)((IREC(I,J),J=1,6),I=1,7)
      READ(5,3)((IPAY(I,J),J=1,4),I=1,7)
      READ(5,5)IDATE
      DO53J=1,7
      DO53I=1,10
      KASYS(I,8)=KASYS(I,8)+KASYS(I,J)
```

```
53      CONTINUE
        DO54J=1,8
        DO54I=1,10
        KASYS(11,J)=KASYS(11,J)+KASYS(I,J)
54      CONTINUE
C INSTRUCTIONS TO DEFINE TRIAL BALANCE AND SUBSIDIARY LEDGER VALUES
        KCASHD=KASYS(1,8)
        KACREC=KASYS(2,8)
        INVEND=KASYS(3,8)
        KFIXED=KASYS(4,8)
        KCOFGS=KASYS(5,8)
        KRENT=KASYS(6,8)
        KWAGES=KASYS(7,8)
        KDEPRC=KASYS(8,8)
        KOTHEX=KASYS(9,8)
        JSDWG =KASYS(10,8)
        KTOTDR=KASYS(11,8)
        KCASHC=KASYS(11,1)
        INVENC=KASYS(11,2)
        KACDEP=KASYS(11,3)
        KACPAY=KASYS(11,4)
        JSCAP =KASYS(11,5)
        JSCUR =KASYS(11,6)
        KSALES=KASYS(11,7)
        KCASHB=KCASHD-KCASHC
        INVENB=INVEND-INVENC
       OKTBTDR=KCASHB+KACREC+INVENB+KFIXED+KCOFGS+KRENT+KWAGES+KDEPRC+KOTH
       1EX+JSDWG
        KTBTCR=KACDEP+KACPAY+JSCAP+JSCUR+KSALES
        IF(KTBTDR.NE.KTBTCR)WRITE(6,9)
        DO55I=1,6
        DO55J=1,5
        IREC(I,6)=IREC(I,6)+IREC(I,J)
55      CONTINUE
        DO56J=1,6
        DO56I=1,6
        IREC(7,J)=IREC(7,J)+IREC(I,J)
56      CONTINUE
        DO57I=1,6
        DO57J=1,3
        IPAY(I,4)=IPAY(I,4)+IPAY(I,J)
57      CONTINUE
        DO58J=1,4
        DO58I=1,6
        IPAY(7,J)=IPAY(7,J)+IPAY(I,J)
58      CONTINUE
        IF(KACREC.NE.IREC(7,6))WRITE(6,13)
        IF(KACPAY.NE.IPAY(7,4))WRITE(6,14)
C OUTPUT INSTRUCTIONS FOR LEDGER MATRIX,TRIAL BALANCE AND SUBSIDIARY
C LEDGER SCHEDULES AT END OF EACH WEEK
        WRITE(6,4)((KASYS(I,J),J=1,8),I=1,11)
       OWRITE(6,6)IDATE,KCASHB,KACREC,INVENB,KFIXED,KCOFGS,KRENT,KWAGES,KD
       1EPRC,KOTHEX,JSDWG,KACDEP,KACPAY,JSCAP,JSCUR,KSALES,KTBTDR,KTBTCR
        WRITE(6,11)IDATE,((IREC(I,J),J=1,6),I=1,7)
        WRITE(6,12)IDATE,((IPAY(I,J),J=1,4),I=1,7)
        IF(N.NE.4)GO TO 59
C INSTRUCTIONS TO DEFINE INCOME STATEMENT AND BALANCE SHEET VALUES AND
C TO PRINT INCOME STATEMENT AND BALANCE SHEET AT END OF EACH 4-WEEK
C PERIOD
        KGROSP=KSALES-KCOFGS
        KTOTEX=KRENT+KWAGES+KDEPRC+KOTHEX
        KNETPR=KGROSP-KTOTEX
        JSCUB =JSCUR+KNETPR-JSDWG
        KTOTAS=KCASHB+KACREC+INVENB+KFIXED-KACDEP
        KOWNEQ=JSCAP+JSCUB
        NETFIX=KFIXED-KACDEP
        IF((KTOTAS-KACPAY).NE.KOWNEQ)WRITE(6,10)
       OWRITE(6,7)IDATE,KSALES,KCOFGS,KGROSP,KRENT,KWAGES,KDEPRC,KOTHEX,KT
       1OTEX,KNETPR
       OWRITE(6,8)IDATE,KCASHB,KACREC,INVENB,KFIXED,KACDEP,NETFIX,KTOTAS,K
       1ACPAY,JSCAP,JSCUB,KOWNEQ
59      STOP
        END
```

Creativity — or original thinking — is perhaps more needed than ever before in business. Yet business may unwittingly hamper some of the conditions that can aid creativity. Here's what can be done to foster —

CREATIVITY IN MANAGEMENT

by Sherman Tingey and Van R. Vibber

Arizona State University

THE BEATLES, pop art, the psychedelic influence, and a changing sense of values among young people have made creativity a popular topic with them. Some of this emphasis has been carried over to the business sphere, since business is extremely interested in today's young people. In fact, business is quite alarmed at the large number of college graduates who enter areas other than business. In an effort to attract first-rate graduates college recruiters and employment advertisements alike are boldly proclaiming, "A job at XYZ Corporation offers you a chance to use your imagination!"

This article deals with creativity and its application and importance to management. It is intended to answer the questions: What is creativity? What are the characteristics of creative individuals? Is there a need for creativity in business? Can management foster creativity? Finally, some suggested managerial guideposts for increasing creativity are also presented in some detail.

What is creativity?

"Creativity is a mysterious force, responsible for pulling primitive man out of his caves into houses, turning his arrows into rockets, supplanting his bison meat with shrimp creole, and replacing his monoliths with skyscrapers."[1]

[1] Eugene W. Jackson, "Hunting Yardsticks for Creativity," *Management Review*, March, 1965, p. 38.

Whenever anything new is developed creative forces have been exerted. In other words, creativity is birth. It is a natural human process. It includes the process of becoming sensitive to problems, deficiencies, and gaps in knowledge. Creativity also includes identifying key issues, searching for solutions, testing and retesting the hypotheses, and finally communicating the results.

The essential tool of creation is original thinking — thinking that takes cognizance of what others have discovered but aims to proceed beyond the point they have reached. Significantly, there is no clear line of occupational demarcation for creativity. It can be found in sports or industry as well as the arts or university research. Whatever is new and has not previously existed, or whatever improves on previous achievements, is creative.

Creative individuals

The creative individual is characterized by his free use of imagination and his willingness to employ fantasy. He produces a fountain of ideas and may suggest alternative ideas with little regard for their practicability. Frequently others think of his guesses as mistakes. He is distinct from the less creative, highly intelligent person who would rather play it safe and produce fewer new ideas but ideas that are more likely to be accepted as logical and practical.[2]

Intelligent people are not necessarily creative people, and vice versa. However, in certain occupational fields that require creativity admittance is based in part on intelligence. This may lead people to the incorrect conclusion that creativity is the same as intelligence. To illustrate, a group of nuclear physicists will have a superior average intelligence quotient, but among them there is no correlation between creativity and intelligence.[3]

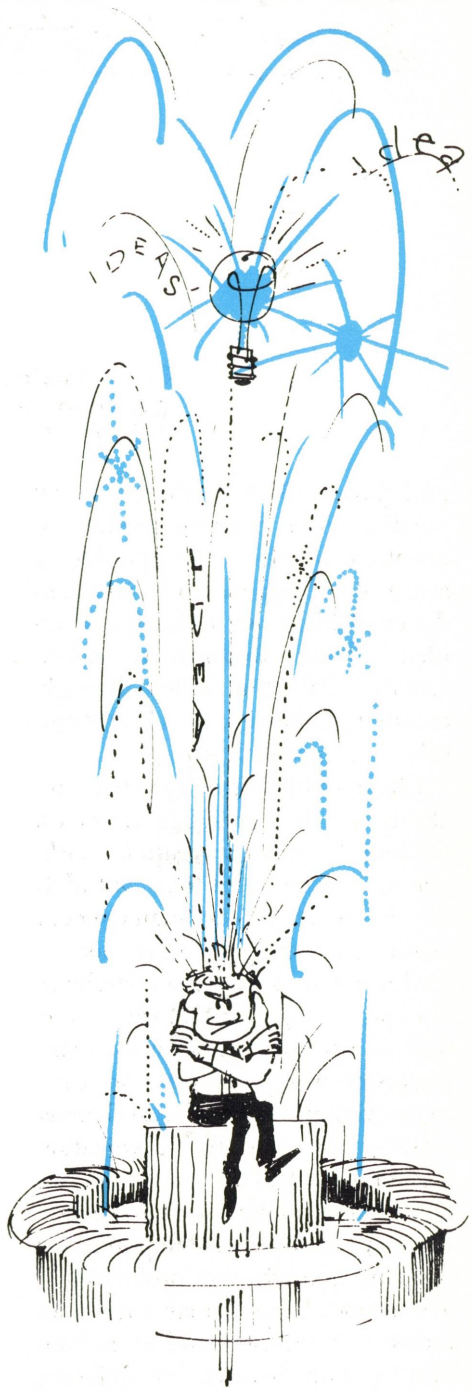
Typically, the creative person prefers complexity, as he has the ability to keep more ideas in his head at one time than the person who is not creative. He is more independent in his judgments and more open to new experience. He is more dominant, adventurous, and emotionally sensitive and is not always pleasant. In addition, he is often more open in his feelings and emotions.

Creativity in business

"Great industries . . . are all aware that however rich and prosperous they may be at this moment, they may wake up tomorrow morning to find that some new product has been invented which makes them obsolete."[4]

According to Peter F. Drucker, the only constant in business is change, and the only profitable way to react to change is to initiate it.[5] Indeed, changes are so rapid that a company must adapt if it is to survive. If it is to adapt successfully, there must exist in the firm an attitude conducive to creative thinking and new ideas. An operation cannot be improved unless it is changed. Thus, creativity is *essential* for the long-run success of a business.

But creativity is not the miraculous road to growth. More often creativity in the abstract is confused with practical innovation in the concrete. Take, for example, two artists both of whom have great ideas for a painting. One tells all his friends; the other dons his beret



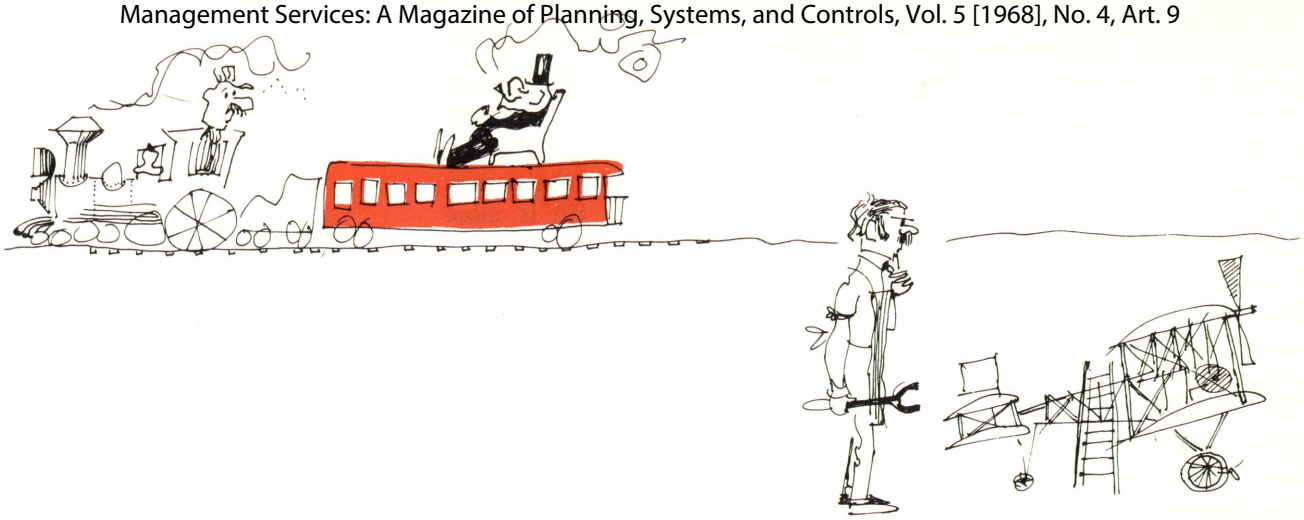
The creative individual produces a fountain of ideas; he may suggest many alternatives with little regard to their practicability.

[2] For a more comprehensive description of the creative individual, see Arthur O. England, "Creativity: An Unwelcome Talent," *Personnel Journal*, September, 1964, pp. 458-461.

[3] Bernard Berelson and Gary A. Steiner, in their book *Human Behavior, An Inventory of Scientific Findings*, Harcourt, Brace, and World, Inc., Chicago, 1964, offer evidence that there is no correlation between creativity and intelligence via a number of studies.

[4] A. H. Maslow, "The Need for Creative People," *Personnel Administration*, May-June, 1965, p. 3.

[5] Peter F. Drucker, "The Objects of a Business," in *Management: A Book of Readings*, edited by Harold Koontz and Cyril O'Donnell, McGraw-Hill Book Company, New York, 1964, p. 50.



Great industries are all aware that however rich and prosperous they may be at the moment, they may wake up tomorrow morning to find that some new product has been invented that makes them obsolete.

and paints. Both might be called creative. What business needs is innovation in the action-producing sense. There appears to be an abundance of ideas but a scarcity of implementation. Business is action-oriented. Without follow-through, creativity is barren, for ideas themselves are useless.

Like anything else, however, creativity can be carried to extremes. *Getting the greatest creativity without sacrificing executive control* is the heart of a key management challenge. Management cannot afford a breed of creative anarchists, nor can management afford to nurture an organizational family more interested in repeating history than in creating it. Obviously, a dilemma exists – how can an organization maintain its flexibility through creativity yet maintain the needed stability and balance required for long-run growth and profitability? The proper balance may vary from industry to industry and even from firm to firm because of differing internal and external environmental constraints. Each firm will have to find its own balance, or optimal mix of creativity and conformity; however, it appears that at present most firms could benefit from more creativity at the expense of some conformity.

Unfortunately, business has not been very successful in relating the real excitement that it can offer to capable, imaginative people; specifically, the opportunity for creativity in business has not been communicated adequately. Instead, many perceive today's business environment as one in which individuality is muffled and creativity is stifled – the view popularized in William H. Whyte's *Organization Man*.

Fostering creativity

Often, early experiences in life enforce conformity rather than creativity. Altering these established patterns is a difficult task. Nevertheless, efforts in the following four areas may serve to develop an environment which can lead to increased creativity.

Firstly, the organization must allow people to act more freely. The creative individual is unique because he reacts differently than others react to the same social forces. For example, he might question the habit of equating the majority rule principle with the majority right principle. He must be allowed to do so if his creativity is to come to the fore.

Secondly, managers must welcome disagreement and contrary viewpoints. Potential creativity and uniqueness are stifled if management expects, or even permits, carbon-copy behavior. Risk and challenge are fundamental to growth, and controversy is inevitable. Too much emphasis on loyalty leads to the equation of loyalty with agreement.

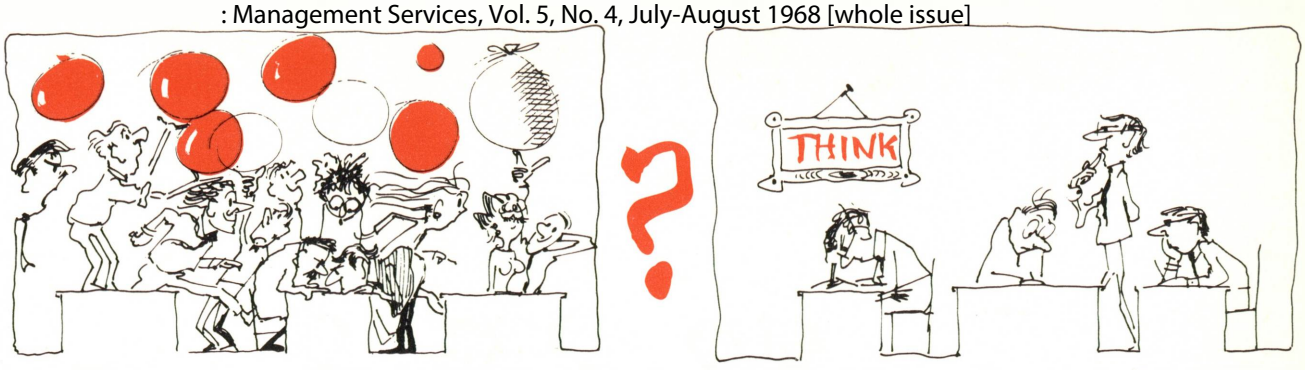
The ominous result: the rapid development of the yes man.

Thirdly, subordinates must be made responsible for, and become personally involved with, change. Everyone in the organization must be encouraged to develop ideas and to take note of others' ideas. Only then will the creative effort overcome the natural tendency to resist change.

Finally, communications must be improved. Communication is often used as a scapegoat for all organizational ills. Nonetheless, one author estimates that fifty per cent of the creative ideas within major corporations are not communicated to the right people. One obvious method of improving communications is the use of suggestion boxes. Yet, surprisingly enough, few companies utilize the idea, even though it is not uncommon to average one hundred ideas per one hundred employees in a given year.[6]

Of course, this division of effort into four areas is somewhat arbitrary. It is only meant to serve as a base for analyzing what detailed

[6] Charles Gibbons, "Improving the Climate for Creativity in Your Organization," *Advanced Management Journal*, July, 1964, p. 47.



Management cannot afford a breed of creative anarchists, nor can management afford to nurture an organizational family more interested in repeating history than in creating it.

steps need to be taken to actually increase creativity.

The question naturally arises whether emphasis in these four areas will lead to increased profits. In most cases where conscious attempts to develop creativity have been employed, companies report a positive impact upon profits.[7] Sikorsky Helicopter, for example, reports a saving of fifteen dollars for each dollar spent on its training program in applied imagination. Under a similar program, Sylvania Electric reports a twenty-dollar saving for each dollar spent.[8] It seems, then, that management can foster creativity and that in most cases it is financially beneficial to do so.

Managerial guideposts

Because conscious efforts to increase creativity appear to be financially beneficial, perhaps it is wise to look at some specific features that might be utilized in a training program in applied imagination. The features listed here are not meant to constitute a complete program; they are merely specific features that might help in achieving the four broad goals outlined in the previous section.[9]

The organization must allow people to act more freely.

Allow freedom for individuals to guide their own work. Provide them with specified and formally agreed upon areas of freedom and self-direction, gradually increasing these areas if evidence of growth in maturity and self-reliance warrants it.

The organization structure should be kept flexible.

Individual differences should be recognized; each person should be treated as a person of worth in his own right. Personnel should be assigned to work where their backgrounds, skills, and interests fit the job rather than primarily on the basis of where they are needed.

Individual personalities should be considered in making assignments and picking leaders or supervisors. Those with special talents and aptitudes should be actively sought out.

Personnel policies and working conditions should be conducive to individual prestige and professional status.

Managers must welcome disagreement.

Lead and motivate by suggestion rather than by command.

Provide opportunity for a variety of experience, change, and learning. Allow people to try occasional pet ideas without premature prejudicial criticism.

Organize special experimental groups where constructive nonconformity and originality are the main goals to be pursued.

Constructive nonconformity should not only be tolerated but encouraged.

Subordinates must be made responsible for change.

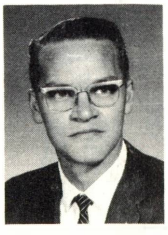
Personal recognition should be provided for accomplishment.

Excellence and extra effort should be rewarded, and special

[7] Jere W. Clark, "Can Creativeness be Taught?" *Management Review*, June, 1965, p. 51.

[8] D. C. Dauw, "Creativity in Organizations," *Personnel Journal*, September, 1966, p. 466.

[9] Many of these features were adapted from the book *Managing Creative Scientists and Engineers*, by Eugene Raudsepp, The Macmillan Company, New York, 1963. Raudsepp discussed only technical personnel; however, the features apply to an applied imagination program for any employee.



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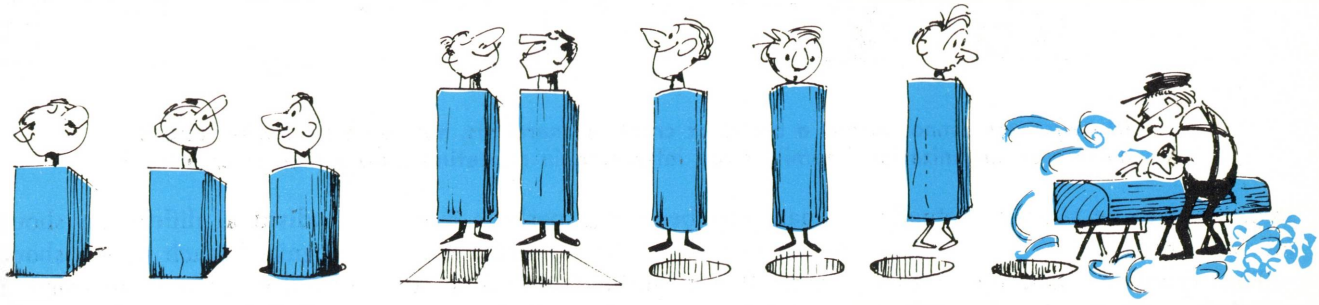
VAN R. BIBBER will receive a master's degree in business administration from Arizona State University this summer. He received his bachelor's degree from Arizona State last year. His business experience includes work with a management consulting firm, with Tener Records, and with the Hartford Electric Light Company, in Hartford, Connecticut.



Personnel should be assigned to work where their background, skills, and interest fit the job rather than on the basis of where they are needed.

incentives should be established for achievers.

Competence should be the primary consideration for advancement.

A high value should be placed on creative effort. Management should provide inspirational beginnings for creative projects.

There should be continuous encouragement for personnel to take refresher and advanced courses. Nontechnical skills, such as human relations, should be taught within the organization.

Workers should be convinced that they, individually, are expected to take responsibility for initiating new ideas and that management will back them up.

Communications must be improved.

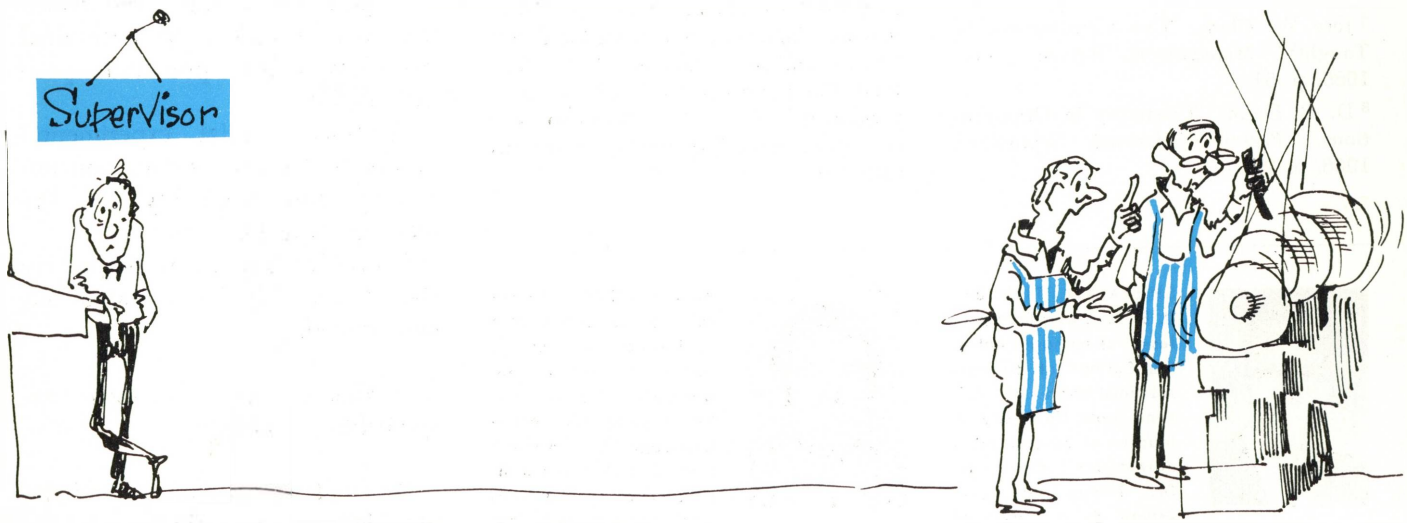
Individuals should be allowed to participate in decision making and long-range planning, particularly in areas which affect them. Personnel should be kept informed about important aspects of company operations, policies, and goals.

Interchange of information and opinion among groups and departments should be encouraged.

Groups should be made aware of the pressure they bring on individuals to conform.

Communication with management should be increased, with regular discussion panels for mutual problems. Personnel should at all times be kept informed as to how timing, budget limitations, and competition will effect the creative effort.

These suggestions should be useful for individual companies to use as a starting point in developing creativity training programs designed to meet their own needs.



All to often, most of the creative ideas within an organization never reach the right people.

The recent conference of AICPA computer users, held in Kansas City, drew the largest attendance of any such meeting to date. Significantly, most of the registrants represented small and medium firms —

AICPA HOLDS THIRD COMPUTER CONFERENCE

A Management Services staff report

THE RAPID emergence of CPAs in the last few years as leaders in the use and application of electronic computers was both noted and documented by authorities at a recent Midwestern meeting. Moreover, those accountants who do not familiarize themselves well enough with computers to understand their clients' automated systems are falling so hopelessly behind the times that they may eventually "pray for retirement."

This was the consensus of speakers at a two-day meeting in Kansas City in May, the third semi-annual National Conference of CPA Computer Users, of the AICPA.

Surprisingly, although most large and many medium size firms were represented, the majority of the more than two hundred registrants were from small firms in small cities. The preponderance of the delegates were from the Midwestern states, but all segments of the country were represented.

Ream featured speaker

Norman Ream, CPA, Special Assistant to the Secretary of the Navy and a former director of the Center for Computer Sciences and Technology of the National Bureau of Standards, said of the history of CPAs and computers:

"The American Institute membership, the accounting profession, has a great deal to contribute to management in this area, and if I might say so, I only have one regret, and that is I think we got into this business about ten years too late at the speed that we are into it now. Then, on the other hand, it's never too late."

Three major changes face business management in the years ahead, said Mr. Ream.

The constant lowering of the cost of handling individual data processing problems, of the cost of image storing, and of the cost of communications will mean that "tomorrow we will be able to bring about very different results from information

technology than we can even imagine today," he declared. "We must talk in the broader terminology of information technology or, if you will, of talking information systems and the ultimate contribution they will make to both management and, of course, eventually to our government and our whole country.

"I think that it's the process of management rather than the hardware that really requires our attention today," Mr. Ream continued, "and, as I said, I'm very, very pleased and, if I might use the term, excited to see the American Institute truly jumping into this problem with both feet."

It's the process of management rather than the hardware that really requires our attention today. . . . .

Three areas of change

The three areas where change can be most readily detected, he said, are in the structure of the work force, the increasing tempo of innovation in business, and the marketing pattern of business. All of these areas are vital in terms of the problems of management information.

The changes in work force will be marked by a sharp increase in the number of creative, educated people within the company's personnel. This will, in turn, call for a much more sophisticated and adaptable management group than has been needed in the past, Mr. Ream believes.

"And this sophistication will only be accomplished through continuous management training," he went on, "and exposure to the new advanced techniques, as they are being introduced.

"This whole situation will continue to become increasingly fluid, and it will be essential that every successful management learn to accept rapid organizational and operational changes as vital to their economic growth," he said.

Increasing rigidity in the cost structure of businesses will also be brought on by changes in the work force, the speaker predicted. For as more technically oriented people assume a larger proportion of the total work load, it will be necessary to ensure greater job stability for these workers.

"Management also faces an equally difficult task in respect to salaries and promotional opportunities for these technically oriented workers," he continued, "for most of them will be specialists concerned with a single field of knowledge or a single discipline, and we must develop the means to direct their work toward a common business goal in order to produce profitable results. And to be effective they will have to be managed by a very competent management team, just as the management team will need the technical knowledge and the dedication of these technical workers to be effective in its efforts. In other words, we have a real communications problem facing us."

Another challenge, he said, is the increase in the tempo of innovation.

"The accelerated increase in the rate of technological development we see will also cause some fundamental problems in the way in which technological innovations will be put to work. For instance, the life of a product is going to shorten. Whereas a manufacturer used to be able to turn out development products and perhaps have a ten-year life span in the consumer market, I think we all know that the life span is probably somewhere down around three years."

Reaction time shortened

This means that the reaction time of management must also shorten, Mr. Ream said, and the only way it can be shortened effectively is through the use and the development of good information.

Many companies today are slipping behind in the competitive race because they remain primarily product-oriented while the successful ones become more and more planning-oriented, he said.

"I'm sure that this has been a philosophy that you have been imparting to management for a long

time," he told the CPA audience. "Our accounting systems are quite good; there's no doubt about that. It's the other type of information, the systems that create information that is not expressed in dollar terms and so on, these are the areas where we are quite weak."

What can accountants, in their role of advisors to management, do to solve these problems?

According to Mr. Ream:

"We have not experienced great difficulty in our ability to define scientific problems, and to apply the computer technology to their solution, for they can normally be expressed in mathematical terms.

"However, I think we've been sadly remiss in our ability to adequately apply computers and advanced technology to the field of management.

"Our great contribution can be the matching of computers and computer technology with the management system and its information system, in order to allow management to be more responsive and thereby to better manage the resources at its command."

Emphasis is on analysis

Past failures to achieve this fully Mr. Ream attributed to too hasty an application of hardware to what was thought to be a particular problem. Fifty to sixty per cent of the analyst's entire time should be devoted to first defining the problem and then finding the proper solution, not in attempting to impose a ready-made solution which might be inappropriate to a problem.

"If we don't do this, we're in the same position as a good doctor who fails to diagnose the case properly and kills the patient by prescribing the wrong medicine," he said.

A second reason for failure in the past has been the tendency of management to push the analyst to engage in a detailed system design too early.

"Management feels this system must be on by a certain date; as a consequence the information technologist or the management consultant or whoever might be engaged in this systems analysis does not have the time because of management pressures to do the proper job, even though he knows that he's being pushed too fast. I think this is where as a profession we have to stand up and be counted. I think we have to tell management that they're making a fatal mistake, that actually they'll never get the return for their investment that they're seeking so hard in other areas."

Norman Ream was the opening speaker on the second day of the May 7-8 conference. The first day had been given over to panel discussions of the present state of the computer industry and AICPA plans in the computer area, a discussion of experience and prospects in working with computers by CPAs with fairly extensive experience in the field, staffing computer activities and how to train staff, and in-house preparations for computer processing of the 1040 Tax Form.

Immediately following the Ream speech on Wednesday, there was a panel discussion of the newly published AICPA book, *Auditing and EDP*, which at that time had not yet been completed and was available to conference members only in galley proof form. Panel speakers were Donald Adams, CPA, Peat, Marwick, Mitchell & Co.; Stanley Halper, CPA, S. D. Leidesdorf & Co.; John O'Donnell, CPA, Lybrand, Ross Bros. & Montgomery; and Joseph Wasserman, Bell Telephone Laboratories. Acting as moderator was Gordon Davis, CPA, now professor of information systems at the University of Minnesota and formerly consultant on computers to the AICPA.

Gordon Davis first described the origins of the book, the men who had worked on it, and its organization. He listed the book's purposes as:

1. To guide CPAs in auditing business enterprises that use computers for record keeping;

Fifty to sixty per cent of the analyst's entire time should be devoted to first defining the problem and then finding an adequate solution, not in attempting to impose a ready-made solution. . . . .

2. To provide a starting point for building an expert consensus on auditing practice when examining such companies;

3. To suggest the utility and application of different auditing methods where there are differences or where experience is still lacking;

4. To provide source material for training and informational purposes.

Following are excerpts from the remarks of each of the speakers on the panel:

Donald Adams (Peat, Marwick, Mitchell & Co.): "Basically, I feel what we have here is a survey of current practices; principally we covered the kind of things that the members of the task force were familiar with and had been working on, the type of things that our firm had been doing. This is a broad look at the kind of things that we're doing now. I think as such it will serve as a foundation for developments in the future . . . And in some of the chapters, particularly where we talk about time sharing, remote terminals, and management information systems, we are suggesting the areas we'll have to look at in the future."

The most important overall control in an EDP system is the independent control group which has responsibility for the completeness and accuracy of transactions and master file changes. . . . .

John O'Donnell (Lybrand, Ross Bros. & Montgomery): "In my opinion *Auditing and EDP* is the most comprehensive and practical treatment of a subject which has left a great deal of confusion in the minds of both auditors and EDP technicians alike. It goes a long way toward clearing the air and placing the various phases of auditing and EDP in perspective. . . .

"The theme throughout the book is that the auditor cannot ignore the computer if he is to have a sound basis for evaluating internal control. The first chapter directs the reader to new control elements found in the EDP system, new control elements to substitute for some of the traditional control elements we're used to.

"The first eight chapters in the book describe these new controls and point out how important some of the controls can be in deciding upon the nature and extent of audit procedures. For example, the most important overall control in an EDP system is the independent control group which has responsibility for the completeness and accuracy of transactions and master file changes which are processed by the EDP specialist. In many instances this independent control group is the user department; for example, the production control department, the cost accounting department, order billing, general accounting and the like.

Individual controls

"One of the controls performed by the independent group is to see that all batches of transactions and the master file changes are sent to data processing, are processed by data processing and in their entirety.

"Another control pertains to the control over errors and rejects which must be accounted for in much the same manner as batch control. For example, in an order billing, accounts receivable type of application, if an independent control group did not exist which had a control over sales orders, shipments, credit memos, and cash receipts, the auditor would have no assurance that the data processing department received all sales orders, invoiced all shipments and credited all cash received to customers' accounts, and made all changes to the master files. In this situation a shipment could be made but not invoiced, causing an understatement of accounts receivable and possibly an overstatement of inventory. I believe that it is safe to say that in a situation or a system with this type of weakness the auditor would do much more to satisfy himself as to the accounts receivable balances at the statement date. This is obviously an oversimplified example, but it does illustrate the need for the auditor to understand outside control over the completeness of processing by the EDP group.

"There are also a number of controls within data processing, some of which we believe may be looked upon as substituting for human judgment or human alertness. . . . Some of these controls are key verification, which improves the accuracy of transaction recording; check digits, which control coding accuracy; input editing, which can include checks for valid codes, valid characters, valid transactions, and valid combinations of fields. . . . The book covers in detail many other kinds of controls, including those dealing with supervision and a separation of duties. . . . It is quite important that the accountant inquire into such controls as supervision and separation of duties between the data processing department and the user departments.

"I believe that the book demonstrates that the auditor can't do his job properly if he ignores the computer. Once the auditor recognizes this new control environment and his obligation to extend his review into EDP, much of the confusion as to his role in auditing a client who uses EDP will disappear.

"If I had to point to the most important objective that this book should accomplish, it would be to remove the fear that auditors have of EDP and put the EDP system in perspective with respect to the overall client system."

Internal auditors' functions

Joseph Wasserman (Bell Telephone Laboratories): "Auditors who don't get involved in EDP should climb upon their stools, adjust their green eyeshades, and pray for retirement.

"I feel that the most important link to any EDP system with the public accountant is the internal auditor. . . . I think that in the book a chapter on the relationship between the internal auditor and your external auditor should be included. I feel that it should define those functions for which the internal auditor should be responsible.

Felix Kauffman, Lybrand, Ross Bros. & Montgomery, New York, although not scheduled on the program, talked on the implications of time sharing for CPAs early in the conference. The editors were so impressed with the content of his talk that Mr. Kauffman was asked to develop his remarks into an article for MANAGEMENT SERVICES. This is being done and the article will appear in an early issue.

"We say that we are responsible for the appraisal of controls being built into a system. That's appraisal. We don't design them. I don't feel that this should be our responsibility. I feel the systems people should be the best qualified. If I can throw a little bomb out here, I don't think the CPA should come into a company and design the internal controls for a computer system and then come back six months later and say 'They're great,' because I'm sure that's all they're going to say.

"Secondly, how do we insure that future systems before they are implemented are properly tested? And again we are not responsible from an auditing point of view for testing these systems, developing all the test media—we're there to make sure the proper test is developed, or a parallel test is run or however you're going to accomplish this.

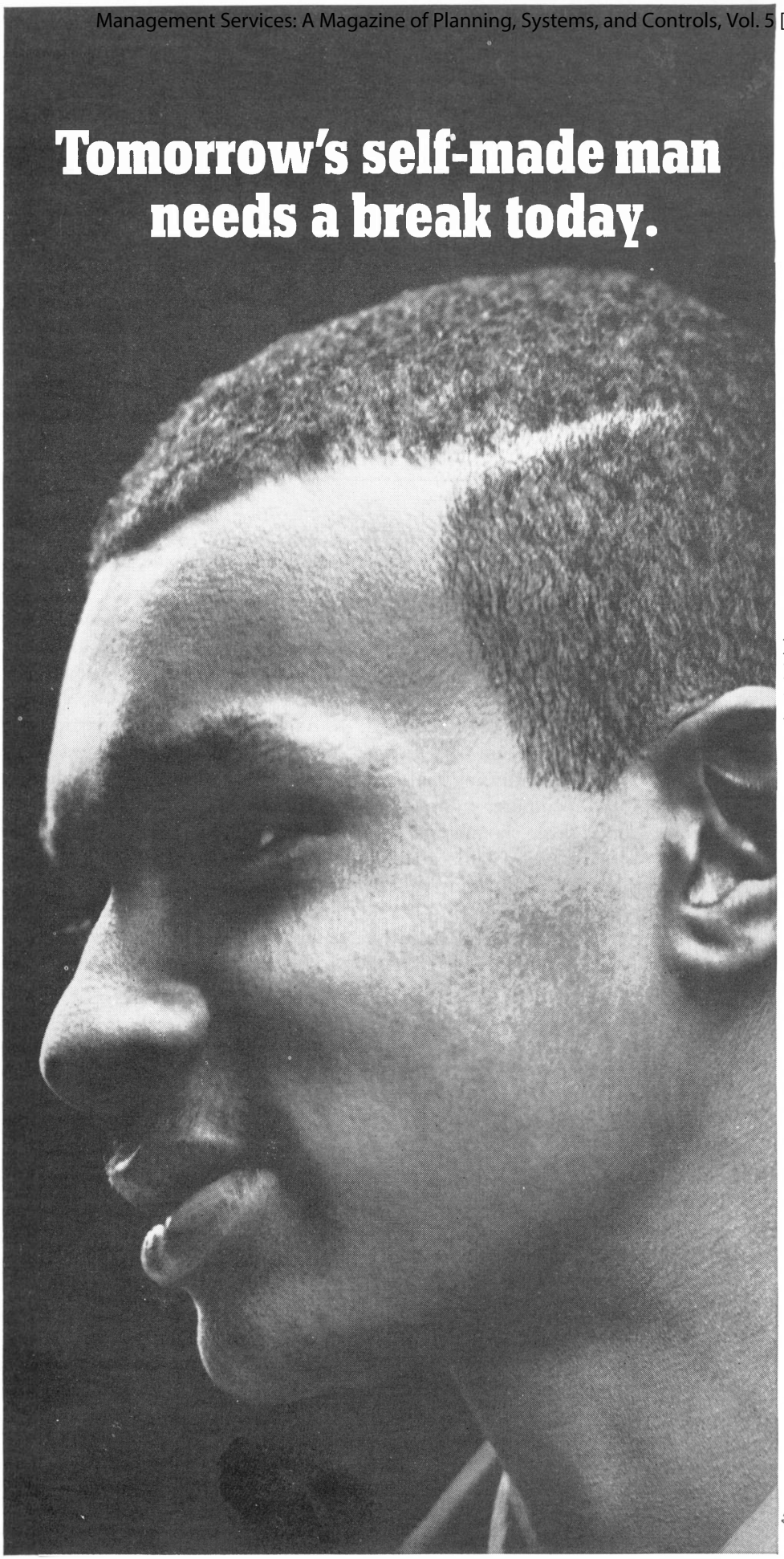
"Third, how do we insure that proper controls are provided for the conversion from either a manual or an existing computerized system to your new system? We want to make sure that we do convert all records, and only once. We've got a few instances where we converted records twice and it makes your file bigger and it's not too economical.

"Next, how do we ensure the auditability of the system? And in this regard, we are looking to the building end of audit techniques within the system. Now, this will solve many of your problems because you won't have to design audit techniques if you have an internal audit staff to work with. There are only a certain number of techniques that we know about. You have sampling, you have extraction, you have comparison, compiling, and you have test media. Now, these things can be built in, and this really is nothing more than saying to the systems people that these are the audit requirements. The systems man who designed a payroll system, for example, goes to all the payroll people to find out how do you process payroll. And from this he designs a system to process payroll and to give that information to management that it needs, from a reports point of view, and hopefully to give at least one check to all employees. But I think we drop the ball—we don't tell them that these are our requirements.

"And the next is to coordinate with the public accountant in the area of controls and audit techniques. This may mean reviewing your own audit procedures for a particular company. And how can you automate your particular audit procedures with that system?"

(First of two parts.)

The next AICPA computer conference will be held November 12-13 at the Marriott-Twin Bridges Hotel, Washington, D. C.



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what people are writing about

BOOKS

Conversational Computers by W. D. Orr (Editor), John Wiley & Sons, Inc., New York, 1968, 227 pages, $8.95.

Businessmen who are aware that time sharing is the wave of the future but don't quite grasp what it is all about may find their answer here.

"Conversational" interaction with computers is a major new phenomenon in its own right, not just another application of computers, the editor of this volume believes. It ranks with such generic concepts as data processing and automation as an element of technological revolution; it "will have an effect on all of us that is at least as profound as the effect of the personal passenger car."

This volume, says Mr. Orr, is an attempt to explain this phenomenon to "the intelligent, curious nonspecialist who, in one way or another, has come to suspect that something is up in the world of computing and would like to know what – if that is possible. It *is* possible."

The technique Mr. Orr has used is to assemble an anthology of "pivotal" writings in the field. All the selections are by specialists, but they lack – or have been "purged" of – technical details. To understand them the reader need not understand how or why a computer works.

The approach is comprehensive. Following some general conceptual selections, the articles describe applications of time sharing to problem solving (with some discussion of simple languages for direct communication with the computer), to computer-assisted instruction, and to information retrieval, with a section on the use of graphical languages.

A section on the computer utility

includes the Federal Communications Commission's Notice of Inquiry, an analysis of the regulatory and policy problems posed by the computer utility and the philosophy behind the FCC's current inquiry. The final selections deal with the psychological and social implications of time sharing and computer utilities, including the issue of invasion of privacy.

The contributors are distinguished. Among them are Dr. Vannevar Bush, former director of the Office of Scientific Research and Development; Charles W. Adams, whose KEYDATA Corporation is considered by some to be the first commercial computer utility; and a number of researchers from The RAND Corporation, System Development Corporation, and other organizations that have pioneered in this field. Nearly every major successful time sharing development is represented, from Dartmouth College to the Los Angeles police department.

No one has yet done a better job of putting the next computer era into perspective. Those who have not yet caught up with the present one would be well advised to read this book.

Time-Sharing Data Processing Systems by JAMES R. ZIEGLER, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1967, 299 pages, $10.50.

The nontechnician in data processing will have to wait a long time to find a more intelligible presentation of this difficult subject.

Time sharing, a "mass distribution" technique for data processing, seems to be the wave of the future in computer usage. It won't be long before everyone who is involved in any way with computers will have to be familiar with it. This book provides a relatively painless way to do it.

Mr. Ziegler, who is director of advanced programing research for National Cash Register Company, has sought to provide a primer for executives and other computer users who are thinking of joining an existing time sharing system or setting up their own.

In remarkably simple language he explains what time sharing is and what it can be used for, offering guide lines for economic feasibility. He reviews the hardware requirements and the software techniques applicable in time sharing implementation. Finally, he poses a realistic problem calling for time sharing; suggests a typical equipment configuration, based on available hardware; and develops the necessary concepts for control programs and an actual user application.

This book is aimed at the user, not the technician of electronic data processing. Its basic objective is breadth, not depth, and its emphasis is on implications and opportunities, not button pushing. For the accountant, consultant, or executive who attempts to keep up with EDP without getting bogged down in technicalities, it should be invaluable.

Management Controls for Professional Firms by REGINALD L. JONES, CPA, and H. GEORGE TRENTIN, CPA, American Management Association, New York, 1968, 206 pages, $9.

The practitioner in any profession —and his accounting advisor—can get a lot of help from this summary of the management procedures that are appropriate when the product is a service rather than a tangible.

In the professions—as in industry —the trend has been toward larger and larger firms. Serious problems of management often result, for the lawyer, doctor, or architect—unlike the industrial executive—is seldom trained or interested in administration.

How to ensure that even in a large firm professional services can be high-quality and profitable is the subject of this book. Actually, the task is much simpler than in an industrial enterprise, for there is only one resource to be managed efficiently, human effort. Simple though it is, these authors point out, this subject has been neglected sadly; this book may well be unique.

Organizational structure and the utilization of time are the key elements in management controls for the professional firm, and both are discussed in detail. Attention is also given to such significant but subsidiary topics as data processing and tax planning.

The authors, partners in the CPA firm of Arthur Andersen & Co., have had extensive consulting experience advising professional firms, and their understanding of the potential roadblocks to good management in these organizations shows in their vivid (though hypothetical) case histories, which are full of human interest.

Their book fills a real need. It should prove of great value to the professional faced with the problem of mushrooming staff and overhead and dwindling profit margins. The professional's CPA firm will find in it an opportunity to supply a much needed management service. And the CPA may even find it helpful in the management of his own practice.

(A chapter from this book appeared as an article in the March-April '68, issue of MANAGEMENT SERVICES.)

Managerial Budgeting for Profit Improvement by WALTER R. BUNGE, McGraw-Hill Book Company, New York, 1968, 236 pages, $9.95.

This guide plays down the accounting aspects of budgeting in favor of its managerial uses.

An effective budget, says Mr. Bunge, is more than merely a means of expressing objectives and mon-

itoring compliance. It is also an effective device for motivating human behavior—drawing out latent ideas, applying psychological incentives, encouraging the use of good management practices, and developing managerial skills.

All these aspects of budgeting are covered in this volume, along with developing budget estimates, cost analysis, flexible budgeting, capital budgeting, cash and asset control, and financial planning. The style is simple, with liberal use of hypothetical case studies ("What do you think is in the cards for next year, Paul?"), charts, and tables.

The author, a corporate director of accounting services and a past president of the Budget Executives Institute, is described in the foreword as a well known "missionary" for the concept of "managerial" budgeting. In this book he has done a good job of proselytizing, particularly for the accountant who may lean to a narrower view of the budgeting process.

Characteristics of an Effective Management Control System in an Industrial Organization by ROBERT H. DEMING, Division of Research, Graduate School of Business Administration, Harvard University, Boston, 1968, 222 pages, $5.

This novel little research study attempts to identify characteristics of effective management planning and control systems.

This book is more than a case study, although an exceptionally detailed case study occupies the bulk of its pages.

The author prepared a detailed description of the planning and control system in use at a multi-divisional manufacturing company carefully selected on the basis of a long list of criteria. Then this description was used by a committee of experts on management control systems to evaluate what they considered to be the strengths and weaknesses of the company's system. Their conclusions, in turn, were reviewed and commented upon by the company's management.

This research process, Defense Comptroller Robert N. Anthony suggests in the preface, is probably unique. "The literature contains a great many descriptions of management control systems, a great many personal observations by participants in the management control process, a number of sales tracts on the merits of proposed new techniques, a small amount of quantitative information on how many companies use this technique or that technique, and a number of textbooks recapitulating all the rest (and also recapitulating other textbooks). The literature does not contain, so far as I know, anything similar to the research reported in this book."

What makes this book different are the comments about management control of a small group of highly competent people – Marshall K. Evans, vice president—management services, Westinghouse Electric Corporation; R. Burt Gookin, vice president—finance, H. J. Heinz Company; Edmund W. Pugh, Jr., vice president—finance, Columbia Broadcasting System, Inc.; and Arjay R. Miller, vice president—staff group, Ford Motor Company—and the case company management's reactions to them. These opinions, and the author's conclusions based on them, have broad applicability in the design of management planning and control systems.

Effective Presentations by EDWARD HODNETT, Parker Publishing Company, West Nyack, New York, 1967, 225 pages, $7.95.

This adaptation of a corporate manual is a real how-to-do-it guide.

This book, subtitled How to Present Facts, Figures, and Ideas Successfully, is a rewrite of a manual originally prepared for executives, chemists, engineers, salesmen, and other professional employees of Dow Corning Corporation. As such, its stress is on the practical.

The first section tells how to develop a presentation tailored to the material and the audience, including how to plan strategy, organize material, and meet problem situations.

The second, and most useful, section adds up to a short course in the use of audio-visual materials – how to choose the right tools; how to make statistics interesting; and how to use charts, graphs, slides, filmstrips, overhead projectors, and motion pictures.

The concluding section takes up various ways of improving oral presentations – how to handle yourself on your feet, how to deal with small groups, how to improve writing style.

For the executive, consultant, accountant, or anyone who must make presentations to groups, this book would be a useful guide.

Office Operations Improvement: How to Cut Costs and Improve Morale by BRUCE PAYNE and DAVID D. SWETT, American Management Association, Inc., 1967, 143 pages, $9.

More a sales pitch than a manual for clerical work measurement, this little volume tells enough about the technique to enable the business man to decide whether he wants to employ it.

With operations improvement (basically work measurement) a company today should be able to reduce its office staff by at least 20 per cent. That is the claim of the authors of this relatively hard sell book on clerical time measurement.

They tell how to select a time measurement method, how to plan and staff the program, how to handle human relations problems, and how to use the resulting data in control. The approach is broad rather than deep; topics touched on

include selling the program to employees, selecting and training analysts, methods improvement, economics of measurement, design and use of performance reports, uses of standard costs, salary administration, and the role of the computer.

From this book, the authors say, the reader should learn enough about the background, details, and procedures of a "total operations improvement program" to develop his own program—but probably not without the help of a consultant.

The Practice of Planning by DAVID EWING, Harper & Row, New York, 1968, 149 pages, $5.95.

This description of planning at the highest corporate levels is interpretative rather than procedural; its emphasis is on overall strategy rather than day-to-day operations.

The Harvard Business School's rich mine of case material plus published case histories are the source for this account of the practice—as distinct from the theory—of strategic business planning, written by an editor of *The Harvard Business Review*.

The text is laced with capsule case histories. As with so many books of this type, the examples are more interesting than the generalizations they illustrate.

The book is deftly written and tightly organized. In clear 1, 2, 3 style the author lists the objectives of corporate planning and discusses two major bases for setting goals; the outside-in approach, that of sizing up potential markets and then organizing the corporation to supply them, and the inside-out approach, that of analyzing the company's unique strengths and resources and building on them.

He describes various methods of appraising the organization's talents and abilities and deciding how to use them — with numerous examples of success and failure from American corporate history. He also evaluates the role of budgeting in strategic planning and briefly explains the major new quantitative tools available, including decision trees and the critical path method.

The result is an interesting if not notably illuminating book, worth reading if only for the case material but not likely to be reread very often by those actually engaged in planning.

Briefly Listed

Information Retrieval: The User's Viewpoint — An Aid to Design by ALBERT B. TONIK (Editor), International Information Incorporated, 2101 Walnut Street, Philadelphia, Pennsylvania 19103, 1968, 311 pages, $12.

This volume, the proceedings of the fourth annual national colloquium on information retrieval, contains twenty monographs on topics related to computer-based information storage and retrieval systems.

Effective Maintenance Management by E. T. NEWBROUGH and the staff of Albert Ramond and Associates, Inc., McGraw-Hill Book Company, New York, 1967, 368 pages, $12.50.

This book, which covers maintenance organization, maintenance systems, preventive maintenance, cost control, planning, estimating, scheduling, evaluation, training, compensation, incentives, reporting, data processing, and just about every other aspect of maintenance, is, the publishers claim, the first to treat the subject in such scope and breadth.

The Uniform Coded Chart of Accounts by ALTON LEE, JR., Quintus Cyntania, P. O. Box 1727, Newport Beach, California 92663, 1967, 285 pages, $27.50.

This little manual, a comprehensive list of general ledger accounts, uniformly coded, is designed to be used as a coding "dictionary" in any organization. It includes an appendix that contains self-checking code numbers.

Progression Handbook by ELLIOTT JAQUES, Southern Illinois University Press, Carbondale, Illinois, 1968, 72 pages, $7.50.

The author of this book led the research team from the Tavistock Institute of Human Relations that started the famous study of the Glacier Metal Company that came to be known as the Glacier Project. Out of this research Professor Jaques developed a systematic, objective method of establishing a differential pay structure and of measuring levels of work. Together with the author's *Time-Span Handbook*, this book is a guide for companies that wish to apply the technique.

Incentives in Manufacturing: Individual and Plantwide by R. C. SCOTT, Volume 3, The Eddy-Rucker Nickels Company (4 Brattle Street, Harvard Square, Cambridge, Mass. 02138), 1968, 48 pages, $1.

This booklet completes the reprint of a series of articles first published in *Circuits Manufacturing* magazine (see M/S September-October '67, p. 59). The series seeks to promote the type of group incentive plan installed by Mr. Scott's company. This volume concentrates on some advantages of group incentives, on the relation between incentives and the guaranteed annual wage, and on incentive plans for salaried people.

MAGAZINES

When You Reach Your Level of Incompetence by LAWRENCE J. PETER, *Think*, March-April, 1968.

Dr. Peter has discovered a new Parkinson-type management principle, elucidated in this amusing article.

Like C. Northcote Parkinson, Dr. Peter (in real life an associate professor of education at the University of California) is interested in bureaucracies. For the study of hierarchies, a new science, he has coined the term hierarchiology. This article enunciates the first hierarchiological theorem, the Peter principle:

Peter principle

"In a hierarchy, each employee tends to rise to his level of incompetence. Every post tends to be occupied by an employee incompetent to execute its duties."

Escalation to incompetence levels has always been inevitable, Dr. Peter points out. An employee who does his job competently thereby becomes eligible for promotion. But "there is no guarantee that the employee who has faithfully done a few things will be competent to do many things. This is the essential weakness of the hierarchy and of the promotion process."

As a case example Dr. Peter cites the example of ten clerks who start as deputy-assistant junior paper processors at Hierarchy Paper Processors, Inc. Half prove incompetent and thus are not eligible for promotion. "They will stay in the positions they are incompetent to fill."

The others reach their levels of incompetence at various levels of the hierarchy. The one who attains the rank of senior paper processor is felled by two heart attacks and compelled to slow down.

Symptoms

Dr. Peter identifies several symptoms that indicate an employee has reached his level of incompetence: phonophilia (an abnormal craving for telephones, intercom devices, and voice recorders), papyromania (the accumulation of needless masses of papers and books); and the Auld Lang Syne complex (persistent complaining about the present as compared to the good old days). Certain physical ailments are also characteristic: high blood pressure, constipation, obesity, allergies, insomnia, peptic ulcers, cardiovascular complaints, and alcoholism; the presence of two or more of these ailments suggests the final placement syndrome.

Solutions are few. The main effect of pre-employment testing, according to Dr. Peter, is "to ensure the competence on initial placement; therefore promotion is hastened . . . to an area of less competence. In the end the employee arrives at his level of incompetence in less time."

The individual employee has two outs. One is substitution, in which he ignores the duties of his position that he is incompetent to perform and busies himself with something he can do. A better one is creative incompetence, by which the employee avoids promotion by creating the impression he has already reached his level of incompetence.

In his conclusion, Dr. Peter promises a book on the Peter principle. Let us hope that he means it.

Appraising Profit Center Managers by JOHN DEARDEN, *Harvard Business Review*, May-June, 1968.

A well known critic of traditional ways of measuring the performance of divisional managers tells what's wrong with the use of the profit budget as a standard — and offers some positive suggestions.

The practice of dividing a large company into small "businesses" and measuring each one's performance on a profit and loss basis has become common in recent years. Each profit center manager sets his own profit goal for the coming year; his bonus is based on how well he meets that objective; and top management's attention is focused only on deviations from the plan.

In theory, this system should be an excellent tool for management control. In practice, according to Professor Dearden, it is generally ineffective, misleading, and unreliable for these reasons:

An equitable profit goal for the coming year is almost impossible to determine, partly because there are too many complex performance variables within the typical profit center and partly because the conditions that will exist during the coming year (particularly the economic climate and the competitive situation) cannot be predicted accurately.

In measuring performance it is almost impossible to separate those causes of variance from budget that result from profit center action (and hence are controllable by the division manager) from those that result from external conditions beyond his control.

A single year is usually too short a time in which to measure a profit center manager's performance accurately. Over the long run profits can be a reasonable measure of performance; in the short run they can be misleading.

Cost control

These criticisms do not apply, Professor Dearden notes, to the manufacturing cost control systems on which the profit budget systems are based. Manufacturing cost control systems meet all the conditions necessary for a successful budgetary control system: It is possible to set reasonable standards of performance, to measure output precisely, and either to control performance variables or to measure the impact of changes in these variables. Profit budget systems, the author charges, do not meet even one of these conditions.

Therefore, Professor Dearden recommends, top management should stop using profit budgets for evaluation of profit center performance. This action in itself would be an improvement, he says, even without the substitution of an alternative performance evaluation system. However, he has another system to propose:

Profit budgets would still be prepared, but they would be used

only for planning—and particularly for changing plans—not for performance evaluation. Performance evaluation would be based only on what has actually been accomplished, not on a comparison with plan.

Shorter periods

The performance period covered would be one appropriate to the profit center, usually three to five years. Evaluations would be made whenever there is a change of division manager or whenever top management becomes concerned about the particular profit center. The evaluation would be conducted by the central finance staff with the assistance of other staff offices. In addition to profit performance, it would probably cover marketing and product positions and organizational and personnel development.

Actually, although Professor Dearden might not admit it, what he is proposing is a return to relatively subjective measures of performance. This may well be justified if, as he charges, today's spuriously objective techniques are doing more harm than good. Specifically, he thinks, they are harmful in these ways:

Dangers

They produce incorrect evaluations and hence inequitable compensation. They motivate profit center managers to maximize short-run divisional profits without regard for the entire corporation's long-range welfare. They encourage the setting of low-level easy-to-attain profit goals. They lull management into thinking that it knows what is happening.

This is a significant article for any businessman, accountant, or consultant concerned with budgeting and performance evaluation. Professor Dearden has done a better job of calling attention to the problem than he has done of solving it, but he has something genuinely important to say.

Managerial Problem-Solving Patterns: An Action Research Program by RAGHU NATH, *Pittsburgh Business Review*, February, 1968.

This article describes a decision making exercise for executives developed at the University of Pittsburgh and some of its results.

Exercise Problem Analysis, a managerial problem solving exercise, was developed for the twin purposes of training and research.

The participant is asked to identify and describe the most important problem he currently faces in his work situation and then to analyze it in terms of force field analysis. That is, the problem is analyzed in terms of two sets of forces—increasing (those forces that are trying to help in the solution of the problem) and restraining (those forces that are working against the solution). He identifies the operative forces in each category, tells which he would manipulate to solve the problem, and why.

The exercise has been administered to graduate students of business administration and to junior and senior executives. On the basis of the comparative results Mr. Nath outlines a few tentative research findings:

The higher the level of the executive the greater the importance of human (as distinct from technical) factors in the problems he faces (as analyzed by the executive). The importance of human factors is least for the students. Thus, Mr. Nath concludes, more emphasis should be placed on behavioral sciences in training at the executive level than at the graduate student level.

In the exercise the primary problem solving strategy selected by the students was that of manipulating the restraining forces only, while the executives chose the strategy of manipulating both increasing and restraining forces. This, Mr. Nath feels, reflects the executives' greater experience with real life organizational situations, where these forces almost always interlock.

Among both students and executives, few seek the "optimal" outcome in their problem solving. Some nine-tenths are content to seek a "satisficing" solution.

Clarifying Responsibility Relationships by T. M. HAMILTON, *California Management Review*, Spring, 1968.

A McDonnell-Douglas Corporation analyst describes the Management Responsibility Matrix, a new analytical tool for spelling out just who is responsible for what.

At Douglas Aircraft a new technique of organizational analysis, the Management Responsibility Matrix, has become a useful supplement to such conventional tools as organization charts, position guides, and detailed procedures.

The MRM is a grid pattern with people, grouped by organizational element, listed across the top and tasks listed at the side. When the appropriate symbols have been plotted in the grid area, reading across any task row will show what degree of responsibility, if any, each organizational element has for the accomplishment of that task. Reading down any individual's column will identify all his responsibilities.

The symbols used provide more refinement of responsibility descriptions than is possible on an organization chart. W performs the work; s provides direct supervision; S provides general supervision; M monitors the work activities; N must be notified; C may be consulted; c must be consulted; R establishes requirements; and A must give approval.

Preparation of the grid, which is a cooperative effort in which all those listed on it participate, immediately spotlights unassigned functions, overlaps of responsibility, and other organizational problems. The discipline of forcing a detailed "think-through" in itself produces some 90 per cent of the grid's bene-

fits, according to the author. However, the finished grid has other applications. It may be used to develop highly accurate position guides, to help in the preparation of detailed procedures, to revise organizational relationships, to sort out interactions in complex management processes, and as an educational device.

This article describes the technique—the development of the grid and its applications—in enough detail for the reader to be able to use it. Anyone involved in organizational planning will find this article interesting, and possibly useful.

An Application of Input-Output Analysis to Some Problems in Cost Accounting, by YUJI IJIRI, *Management Accounting*, April, 1968.

This paper illustrates the techniques of input-output analysis applied to some interdependent cost accounting problems. Those who understand matrix algebra will find this article of interest.

Input-output analysis was originally developed to find relationships among the basic inputs of industries, the transactions among industries, and the final outputs of these industries. This author applies input-output analysis to these same activities within a single firm. The example used is a situation found in petroleum refineries, chemical manufacturing, etc., where part of the final output produced is combined with raw materials to produce more of the same output.

The first problem is to find unit costs of the products. Once this is done internal transaction entries can be prepared using dollar amounts. The second problem is cost analysis of the inputs of raw material, labor, and overhead contained in the final products. This analysis yields an easy way of computing the effects on the final product costs of a change in the cost of any of the inputs. This cost analysis works equally well where all costs are variable or where part of the costs are fixed and part are variable. The variable unit costs derived by the cost analysis may be used as a criterion in make or buy decisions for the various products.

These problems are analyzed on the basis of output coefficients. The author then goes on to show that the same problems can also be analyzed on the basis of input coefficients. He illustrates the use both of dollar input coefficients and of physical coefficients, based upon quantities, where dollar amounts are not available or necessary. The quantities used need not be homogeneous; they may be in any mixture of units such as pounds, gallons, ounces, pints, etc.

Assumptions

Input-output analysis is based on two assumptions. The first is that the products produced by any process are all homogeneous. The analysis cannot be applied to processes which produce joint products or by-products unless the process can be divided into a process for each joint product or by-product. This is necessary because each cell in a matrix represents a single input or output.

The second assumption is that the input and output coefficients are constant. That is, there must be a linear and proportional relationship between the inputs and outputs regardless of the volume involved. For example, if it takes one quart of product X and 1 pound of product Y to produce 1 gallon of product X, then it must take 1,000 quarts of product X and 1,000 pounds of product Y to produce 1,000 gallons of product X. If the relationship between the inputs and outputs is linear and nonproportional, the technique may be applied but with care.

Other difficulties mentioned in the article include these: Predetermined costs cannot be used if opportunity costs are desired; self-consumption costs cannot be netted if cost data are to be analyzed dynamically; and endogenous sectors cannot be manipulated during analysis.

Input-output analysis as a tool can be very useful in solving interdependent cost accounting problems. Anyone working in this area would do well to read this article as well as the references cited.

DONALD K. BERQUIST
University of Washington

The EMSI Story by GURDON W. LEETE, *The Lamp* (Standard Oil Company of New Jersey), Winter, 1967.

This description of how Jersey Standard and its affiliates are using operations research techniques is sketchy but provocative.

Esso Mathematics & Systems Inc. (known as EMSI or Esso Math) was established in 1966 to coordinate the application of mathematics, computers, and business systems throughout the Standard Oil Company of New Jersey system.

Computerizing of accounting and statistical operations, now nearly completed, has produced annual savings of about $30 million. But Jersey's use of operations research techniques is more interesting and potentially still more profitable.

This article describes only a few of these applications and those briefly. One is a model to schedule supplies of crude oil from all over the world to twenty-two European refineries and the distribution of finished products to thirty or forty major European terminals. (There were ten to the five hundredth power theoretical combinations from which the computer had to choose the optimal.)

Another is a model for designing a system for moving natural gas from the interior of Libya to a port, liquefying it, and then shipping it to Spain and Italy. A key problem was the impact of winter storms in the area of the port. The model had to determine how much storage

capacity was required at the port to allow for failure to ship in bad weather, how many ships would be needed, and how much storage capacity to build in Europe. Other examples are touched on briefly.

Although this is far from a how to do it article, it provides an interesting glimpse into OR in a major company.

The Real Low-Down on Materials Management by GREGORY V. SCHULTZ, *Factory*, December, 1967.

On the basis of an opinion-gathering field study, it is concluded that the forecasted "magic" technique of materials management, as practiced today, has not achieved total systems cost reduction.

The materials management (MM) concept was developed from the central idea that there are only four key manufacturing control areas—men, machines, money, and materials. The MM position is that all of the materials-related functions, i.e., purchasing, production and inventory control, materials handling, packaging, traffic, and distribution, should report to a single manager. Under this organizational structure, the natural conflicts between these departments can be resolved at a central point, with the solutions taking account of the companywide, or total systems, impact of each decision.

To evaluate the effectiveness of the MM theory in actual practice, a senior editor of *Factory* traveled 9,000 miles gathering opinions from managers who had tried the concept. In this article, the author presents his conclusions and follows with excerpts from seventeen of the interviews.

The author defines total systems cost reduction as "a significant systems change that affects sales, production, and distribution simultaneously." He reports that none of the managers he talked with initiated MM for the specific purpose of accomplishing total systems cost reduction. Only two companies had, in fact, realized such a result after several years of experience with MM, and in one of these cases it was by accident.

Objectives

The reasons given for instituting MM were these: (1) conversion from centralized to decentralized management, with MM being established as a basic profit center (nine companies), (2) a need in a corporate acquisition for a plant or division materials manager who could uncover problems in critical areas of the acquired plant (five companies), (3) a need for a skilled materials manager who could carry the load for inexperienced or technically obsolete subordinates (three companies), and (4) a need for putting the materials acquisition and flow system in order prior to computerization (three companies).

In evaluating MM's claim of "forced" coordination among departments, all of the managers surveyed agreed that MM resulted in reduced lead time for purchased materials and parts, fewer parts shortages, more realistic buying policies, and better finished product delivery performance. However, it was felt that the value of the materials manager was diminished once this coordination had been established, policies formalized, and the whole put on the computer.

Inventory reduction

The other big advantage claimed by the managers for MM was inventory reduction with lower materials prices. Companies with "true" MM agreed almost unanimously that it cut inventory 20 to 40 per cent and increased inventory turnover by two turns per year. Significant inventory cuts were reported even by companies that had only recently adopted MM. These reductions were achieved through coordination on all fronts, including sales and marketing, along with the discipline which was forced on production managers and design engineers.

One-fourth of the surveyed companies indicated that 50 to 80 per cent of all MM savings came from the purchasing function through such routes as annual purchase contracts, material substitution, and value analysis.

In the author's opinion, the failure of MM to move aggressively into total systems cost reduction is the reason why MM's savings (other than inventory) are purchasing-oriented. Furthermore, he feels that unless MM breaks through its self-imposed barrier, such savings can be gained just as well by upgrading the purchasing function. Support was given for this view by the two surveyed companies that had abondoned MM.

Mr. Schultz predicts that the increased use of sophisticated computer systems, which have real time interfaces with all parts of the business organization, will make MM unnecessary.

VICTOR POWERS
University of Washington

A Descriptive Model of the Intra-Firm Innovation Process, by KENNETH E. KNIGHT, *The Journal of Business*, October, 1967.

Professor Knight describes innovation as the adoption of a change that is new to an organization and to the relevant environment. The process of innovation is considered as a special case of the process of change in an organization. In his theoretical analysis of innovation, Professor Knight offers hypotheses about the innovative process and discusses situations that are likely to produce innovations.

The fundamental thought in the teaching of the Greek philosopher Heraclitus (535-475 B.C.) was that the universe was in a state of ceaseless change and that "one could not step twice into the same river, for other and yet other waters are ever

flowing on." Processes of change and adaptation have long perplexed students of human behavior. In more recent years researchers have given considerable attention to organizational adaptation, change, and innovation. Professor Knight's article is one of seven articles in this issue of *The Journal of Business* focusing on the process of organization innovation.

Definition

Professor Knight characterizes innovation as the "adoption of a change which is new to an organization and to the relevant environment." The process of organization innovation, considered a distinct subset of organization change or adaptation, is discussed in terms of two major phases: the creation of the idea and its development and the introduction and adoption of the idea.

The creation and development of an idea is discussed in terms of certain characteristics of creative individuals and the characteristics of organizations that foster creativity. Most of the research that has been done on innovation has been directed toward this phase. Professor Knight's concept of organization innovation, however, includes not only the conditions for creativity but also the process by which new ideas are introduced into an organization. His classification of organization innovation includes four types: product or service innovation, production-process innovation, organizational structure innovation, and people innovation. These four types of innovation are considered to be highly interrelated so that an innovation of one type is likely to create or be met in return by changes in one or more of the other three categories. Equally important, each of these four types of innovation can have either a positive or negative impact on the goal achievement of an organization.

Professor Knight also considers the extent to which an innovation differs from existing alternatives by describing two types of "radicalism." First, performance radicalism is defined as the amount of change in output that results from the introduction of a new idea. Second, structural radicalism defines the extent to which the structural arrangement differs from existing ones. Together these two measures of radicalism provide a framework for describing the extent to which different innovations are adopted. Organization innovation is conceived of as an ongoing process through which organizations attempt to adapt to pressures for new products, new production processes, modifications in organizational structure, new people, or continued education for current personnel. Professor Knight hypothesizes that organizations differ in their recognition of the need for change, in their search patterns, and in their search procedures to find satisfactory solutions. He presents a general model of organization search for innovation which consists of three categories. First, routine or programed innovation includes minor product or service changes, production-process changes, and the normal movement of people within an organization. Programed innovation may include all of the types of innovation described earlier but is identified by a low degree of radicalism as compared to present alternatives.

Non-routine innovation

Second, slack innovation, a situation in which the organization perceives itself as successful, is a form of non-routine innovation. Slack innovation includes wide search activities external to the organization and emphasizes product, service, and production-process innovation. It is hypothesized that in a situation reflecting slack innovation there is very little disruption of the internal organizational structure.

Third, distress innovation, a situation characterized by the unsuccessful corporation, is another type of non-routine innovation. Distress innovation is conceived of as a continuum of change from rather mild internal changes to wide and random search for radical organizational change.

Requirements

Within this general model of organizational search, the innovator represents the interface between the creative idea and the organization. An innovator must first have an idea and the desire to introduce it. Innovation is a conscious effort to create change. Involved in such a change are problem recognition, search processes, and problem solution. The problem-solving process is tempered by the innovator's role in the organization, his beliefs about himself, and his relationships with other people. Problem solving is a process of cognition, and emotional and social factors are likely to play an important part in the behavior of the innovator.

Second, the innovator must have the means by which he can successfully bring about change. He must have the power to innovate. He must have control over those aspects of the environment that will be altered. Organization power can be viewed as accruing to the position an individual occupies in the formal organization hierarchy or formal decision making and task activity structures. Organization power can also be viewed as accruing to individuals through informal networks of interpersonal relations and cohort groups. Together, informal and formal sources of organization power provide a broad spectrum of means by which the innovator can successfully introduce new ideas.

Limitations

Professor Knight explicitly recognizes that his analysis represents only a limited description of intrafirm innovation. He acknowledges, for example, that a manager could not take his model and use it to determine the optimal way to bring about specific innovation in an organization. His analysis of innovation, however, can provide inter-

ested practitioners with an awareness of the complexity and interrelatedness of the elements of organization innovation. Professor Knight's article will be of additional interest to managers and accountants through its excellent presentation of recent developments in the description and analysis of organization innovation. The article also contains an extensive list of references.

ROBERT J. SWIERINGA
University of Illinois

The Instant Executives, *Forbes,* November 15, 1967.

Using Booz, Allen & Hamilton as a case, a business magazine looks at the management consulting field.

As everyone knows by now, management consulting is a booming field. This article takes a look at its current state and particularly at the largest of the conventional management consultants (excluding CPA firms), Booz, Allen & Hamilton.

Little is said about the accounting firms. A Booz, Allen executive is quoted as charging them with conflict of interest, and their built-in advantages in terms of prior knowledge of the company and training in quantitative thinking are noted.

The article's conclusions are not very startling. The pros and cons of consulting – and of large versus small firms – are fairly familiar by now.

But some of the information provided may be useful to someone interested in doing consulting, for example, Booz, Allen's billing rates ($25 an hour for a junior consultant, $75 to $200 an hour for a senior officer) and its formula for success ("You don't break even unless you are keeping your people at least 90 per cent utilized . . . The real secret is to get 105 per cent utilization."). *Forbes* has dug up a number of critics of consultants' methods, too, and their comments provide a handy list of don'ts.

The Browsing Era by RICHARD E. SPRAGUE, *Business Automation,* June, 1967.

Long a fan of on line-real time systems, Mr. Sprague seeks to refute the claim of skeptics that management doesn't really need them.

A new, as yet not definitely named, era in the use of computers is dawning, Mr. Sprague says. In the past he himself has referred to this era as that of on line-real time systems (see "On Line-Real Time Systems – 1964" by Richard E. Sprague, M/S May-June '64, p. 40). In this article, adding the concept of time sharing, he calls it the era of the computer conversational or "browsing" mode.

Already, he points out, more than fifty time sharing computer centers all over the country are letting scientists, engineers, professors, and students solve problems by trial and error conversation with a computer in their own language. Time sharing is also having a revolutionary impact on education and on library and medical research.

The most significant effect, in Mr. Sprague's view, will be on management. He takes issue with the skeptical view of Harvard Business School Prof. John Dearden that "A real time management control system . . . would not help to solve any of the critical problems even if it could be implemented."

The conflict stems, according to Mr. Sprague, from differences in the definition of real time. Professor Dearden uses the term to mean that information in the system is up to date within seconds from the time an event occurs that generates the information. That kind of real time system may well have limited application.

Mr. Sprague's real time is related to the time required to obtain information from the system, not to its currency. For this kind of real time system there is a genuine and nearly universal need. "The important consideration is that when the manager needs information for whatever reason he needs it now."

Mr. Sprague goes on to describe a real time (in his sense) "browsing" system based not on a "total" management information system blanketing the entire organization but on a group of tailor made systems in which each executive has his own personal data base (including his own appointment calendar, schedule, telephone number listings, etc.).

Such a system, Mr. Sprague concedes, will be unstructured and wasteful from a system designer's point of view. But he finds it highly probable.

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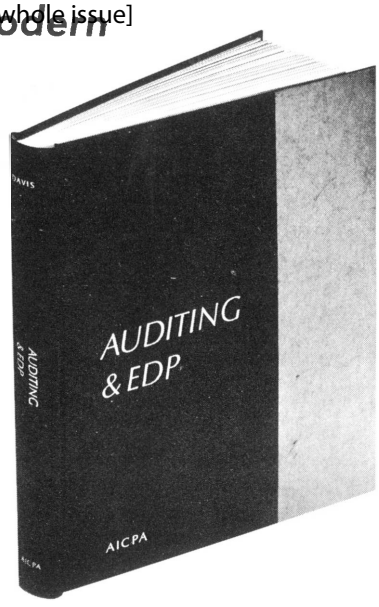

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By Gordon B. Davis, CPA, Ph.D.

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