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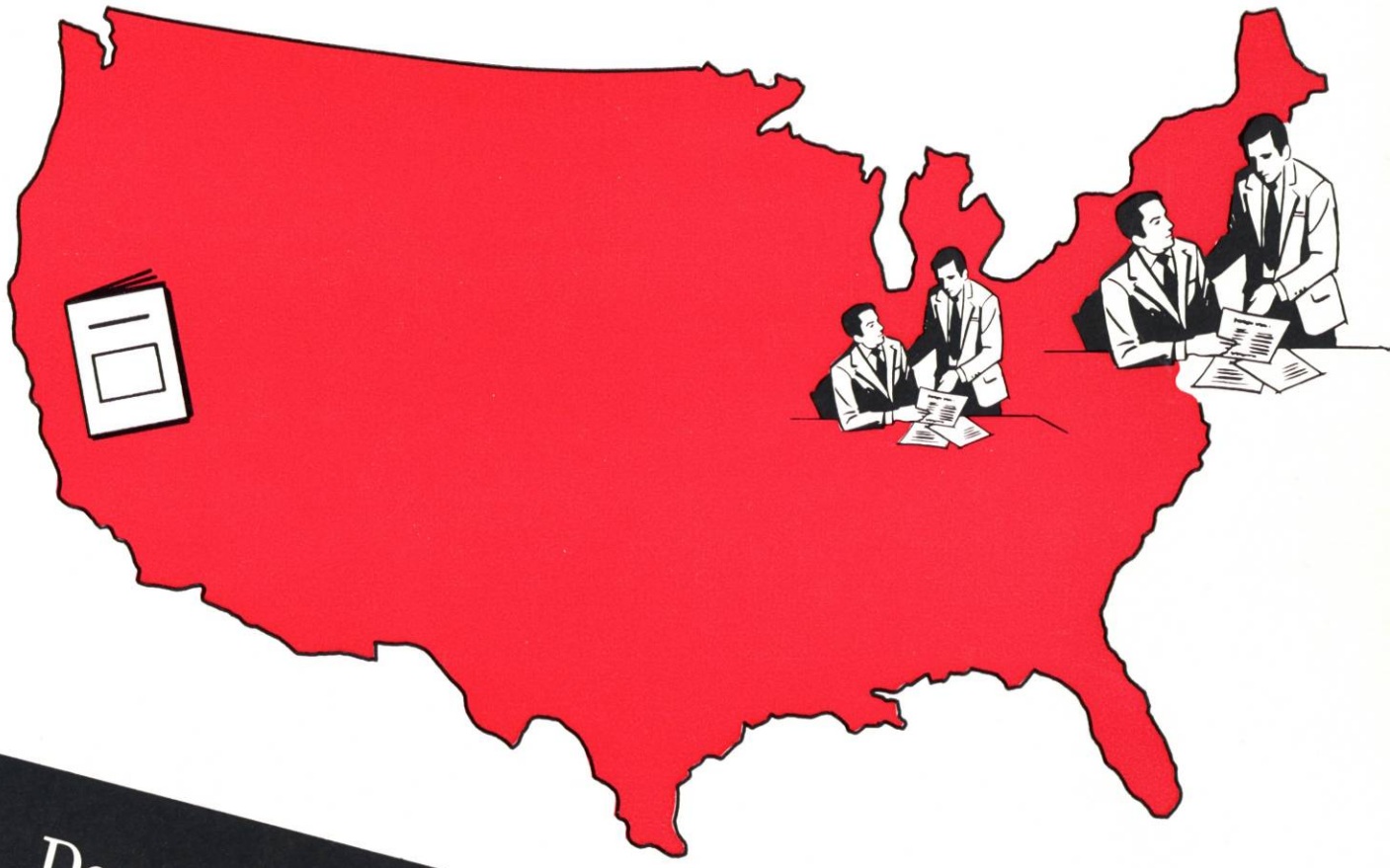

Down-to-Earth Marketing Information Systems

Neil Doppelt

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.

BBB®

MANAGEMENT ADVISORY SERVICES FORUM

Gentlemen:

As a production planner/scheduler, I am faced with a vexing problem—how to reduce my company's in-process and finished goods inventory, while maximizing labor and machine utilization during our peak selling season. Our product line is electric meter sockets, and the current scheduling procedure is to produce a weekly production schedule regardless of what is or is not completed from previous schedules. The result is an outstanding overlay of approximately 12 schedules, which creates artificial demands on the in-process inventory, consequently, inflating it.

I would like to compress the 12-schedule overlay to one schedule by applying the maximum resources available to solving the daily and weekly production problems. How may I do this in the face of some hostility to change from management personnel, and without adversely affecting customer demands in our peak season?

The reply, received from one of the national firms on our panel:

The problem of reducing in-process and finished goods inventory, while maximizing labor and machine utilization and providing desirable customer delivery service levels, can be among the most difficult operating problems facing management. The peak season always brings the problem to a head since this is the period when customer delivery service falls off and

it is then that the matter is called to the attention of management by the customers if not from within the company. Management often takes action similar to what you describe in an attempt to satisfy the customers regardless of the disruptions and costs in manufacturing. Present state-of-the-art in production scheduling taking into account all the economic and priority factors simultaneously to obtain a balanced optimum solution is very complex and applies only under certain prescribed conditions which your operations may or may not satisfy.

Fortunately, however, there are several very practicable steps that can, at least, alleviate the problems concerning you. As you are surely aware, a good production schedule is dependent upon realistic measurement and recognition of production capabilities and work-in-process inventory status and reasonably reliable demand forecasts. Further, timely and comprehensive feedback on changes in demand and actual production on the shop floor enhance flexibility in scheduling to cover demand at lowest cost. Recognizing the difficulties you mention, we make the following suggestions, some preferred and some that are "just the best under the circumstances," hoping that you may find one or more helpful for both temporary relief and long-term progress.

Suggestion 1. Review actual production accomplished during recent periods and evaluate production capacity standards. Thereafter, only schedule quantities that can actually be completed during each week. To preclude concern with the possibility of completion ahead of schedule, overlap material availability for next schedule period.

Suggestion 2. If you cannot take advantage of Suggestion 1, and must stay with present over-scheduling, set up close control of the release of material to production so that it ties in with the actual completion rate and all units started are actually completed. Then, even though your schedule may show open balances, unnecessary labor will not have been invested and the floor will be clear, facilitating the production of the next items sooner. The production planning and scheduling function will be greatly simplified, because the outstanding overlay of schedules will represent unstarted production the same as any other new schedule quantities.

Suggestion 3. If you cannot effect Suggestion 1 or 2, you may be able to help the immediate situation and bring focus on the magnitude of the problem by physical segregation and control. Set up a special area in stores or other available space out of the path of production work to line up the unfinished work in process from previous periods. Sometimes physical identification by schedule period is very effective to get a point across in addition to the aggregate. Full realization of the magnitude may be your breakthrough with management. In the meantime, production can proceed more efficiently without the obstruction of the unfinished material from old schedules and you can also control which is to be cleaned up first instead of having it completely up to the shop. This approach may also be useful in conjunction with Suggestions 1 and 2.

Suggestion 4. If you cannot carry out Suggestion 3, try the same thing on paper, identifying the space and dollar investment and other unnecessary costs in total and by time period, proposing Suggestion 1 or 2 to correct the situation.

Suggestion 5. If you are not successful with Suggestions 1, 2, 3, or 4, take this approach to preclude any worsening of the situation. Maintain close and accurate readings of the actual material status from schedule overlays and incorporate them into the next schedule for the same item, preferably as *part* of the normal schedule quantity, rather than an additional amount. In this way, you may always have some residue work in process, but it won't be continuously building up.

Suggestion 6. The foregoing suggestions, quite obviously, are aimed at resolving the physical problems creating unnecessary inventory and production costs. Regardless of your success using these approaches, an estimate of the individual and aggregate costs, no matter how approximate, may prove very useful. If the cost differential, i.e., producing weekly production schedule quantities as you now do vs. significantly larger or smaller quantities, is nominal, then you would want to concentrate your efforts on the physical problems as in Suggestions 1 through 5. If, on the other hand, there is significant money going down the drain, you would have the facts in terms management would appreciate to, first, experiment with different possible plans and schedules to find the best and, second, to prepare a convincing package that management might find difficult to reject. But make sure your presentation is complete and be prepared for questions and criticisms. Develop an overall plan of action; describe the improvements and benefits in production costs, inventory investment, customer service, and, perhaps most important of all, how convenient and useful it will be to sales and other members of the management team.

These men believe in the importance of excellent higher education.

They know it can't be maintained without increasing business support.

Many large corporations and small businesses are contributing generously to colleges and universities. The men who head these businesses are urging others to join them—with larger investments—or by starting a company aid-to-education program.

Business needs college talent in increasing quantity. But rocketing costs are causing a financial crisis for colleges and universities that could impede educational progress.

If your business has not recently evaluated the self-interest importance of investing in higher education, it should do so now.

Tuition, on the average, covers but ⅓ the cost of a college education. More help from more businesses is needed to contribute importantly to the other ⅔.

Give to the college of your choice.

Special to management—a new booklet of particular interest if your company has not yet established an aid-to-education program. Write for: "How to Aid Education," Council for Financial Aid to Education, 6 East 45th St., New York, N.Y. 10017.

Joseph C. Wilson, Chairman
Xerox Corporation
Rochester, N. Y.

Charles B. McCoy, President
E. I. du Pont de Nemours & Co. (Inc.)
Wilmington, Del.

J. Irwin Miller, Chairman
Cummins Engine Company, Inc.
Columbus, Indiana

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(formerly *Management Services*)

people, events, techniques

Economists Warn of Renewed Inflation Under Nixon Plan If 90-Day Wage-Price Freeze Is Not Extended

Amidst the euphoria that reigned on the New York Stock Exchange on the 16th of August, following the President's Sunday night speech announcing complete reversal of his previous economic "game plan," and the generally startled reaction of governments abroad and labor spokesmen at home, a note of cautious warning began to appear in the statements of economists about the effectiveness of the New Economic Policy.

Particularly controversial, at least domestically, was the imposition of the 90-day freeze on rises in wages and prices. While businessmen were generally pleased, economists felt that the 90-day period was simply that, a pause that could end with inflationary pressures even higher than they have been in the past. Labor leaders were, of course, particularly bitter, especially those whose unions have not yet achieved sizable strike gains so far this year.

John Kenneth Galbraith, Harvard economist who was head of the Wage-Price Control Board during part of World War II, said that the 90-day freeze was long overdue, and that the country has been edging toward some form of wage-price controls for years.

"As long as one has strong unions and strong corporations, one is going to have competition between the unions and the corporations that can shove up prices," Galbraith said in an A.P. interview printed in the *New York Post*. "So, there is going to be a continuing need for some kind of wage-price restraint. Those who think otherwise are fooling themselves."

He said that if the 90-day restraint is extended, the average worker will gain because pension funds and savings are better protected than they have ever been.

Paul Samuelson, the MIT economist, was more cautious than Galbraith, conceding that if the 90-day freeze is not extended, some wage and price hikes will occur with a vengeance, but he said he believes the momentum of inflation will have been broken.

Allen Stults, president-elect of the American Bankers Association, suggested that controls should be maintained until they seem to be working well, and that then they be dropped with the clear proviso that they will be reimposed if inflation becomes severe again.

It is an understatement to say organized labor's leaders are not pleased with Mr. Nixon's 90-day wage and price freeze. George Meany, president of the American Federation of Labor and Congress of Industrial Organizations, has called the freeze "patently discriminatory" against American workers.

"In the absence of effective machinery to insure enforcement on the price front and equity on the wage front, the entire burden is likely to fall on workers covered by highly visible collective bargaining contracts," Mr. Meany said in a prepared statement.

Leonard Woodcock, president of the United Automobile Workers, told the union's skilled trades convention that the U.A.W. would fight any extension of the wage freeze that would eliminate the union's upcoming wage increases.

"If they want war," Mr. Woodcock said referring to the Administration, "they can have war." The U.A.W. is filing suit to test the Administration's legal right to make unions give up the increases scheduled to go into effect during the 90-day freeze.

Raymond R. Corbett, president of the New York State A.F.L.-C.I.O., pointed out the President's controls did not cover corporate profits or interest rates. "Further, the whopping proposed 10 per cent investment tax credit for industry looks like a further giveaway and advance payoff to big business for industrial investment," he said.

As Paul Jennings, president of the International Union of Electrical Workers, sees it, the President's approach is "the outmoded and discriminatory trickle down theory." According to Mr. Jennings, this entails giving direct benefits to business in the belief that it will result in some "crumbs for the people at some later stage."

Another labor leader, John Henning, president of the California State Labor Council, A.F.L.-C.I.O., complained about the lack of corporate controls in the President's program. "Our biggest objection would be to having no profit control. We have been calling for wage, price, and profit controls all along."

The chief Federal labor mediator, J. Curtis Counts, has requested that workers now involved in more than 350 strikes across the country return to work for the freeze period. Mr. Counts said that while the Administration believes it has the legal power to force the strikers back to work it would prefer voluntary cooperation.

Economic Gains May Cause Urban Collapse, Banker Warns

If the economy recovers, one or more of our cities may collapse, warns John R. Bunting, president of the First Pennsylvania Banking and Trust Company, in an article in the summer edition of the Temple University *Alumni News.*

"Financial disaster for the cities begins with an improving economy. As the economy gets going, in those occupations where it applies, productivity will increase. The productivity gains will provide rationales for wage contracts to be expanded proportionally, but these wage and salary increases will be matched by employees in jobs where productivity gains are unlikely or impossible," Mr. Bunting writes.

Cumulative productivity increases like those in manufacturing cannot be expected from the police, teachers, social workers, hospital orderlies, or other employees in service fields, and the urban crisis in part grows out of this fact, he concludes.

"Never again will the gap open between the buying power of employees in the two [manufacturing and service] groups. As industrial wages and salaries go up in line with productivity, service wages will follow: the relationship is inevitable," Mr. Bunting says.

"No realistic revenue sharing proposal will make it possible for cities to cover their costs as they soar to higher and higher amounts," he continued. "An effective incomes policy is the only means we have of bringing the costs of city government back under control."

Mr. Bunting proposes that all labor agreements must be held within a range related to productivity gains in the economy as a whole. In turn, in industries where productivity gains are high prices should drop.

"If price declines did not occur, price controls or special taxing would prevent the concentration of the economic benefits of wage control in the hands of a few large manufacturing corporations."

Mr. Bunting urges businessmen to force a return to discipline in the economy.

25th Anniversary of Computer Marked at ACM Chicago Meeting

The 25th anniversary of the invention of the electronic computer was celebrated by the Association for Computing Machinery at its annual conference August 3-5 in Chicago.

It was an odd celebration, for, instead of heaping compliments on the machine, speaker after speaker found fault with it and its accomplishments.

Computer equipment manufacturers "have all too frequently encouraged advancement of the state of the art at all costs and change just for the sake of change," William J. Osterman, director of product and market planning for Auerbach Information Services, told the convention.

However, Mr. Osterman believes that the recession will force computer users to match computer usage and capabilities more closely.

Harvey Golub, principal in McKinsey & Co., Inc., introduced a disquieting report on research he recently completed. Mr. Golub found that no significant competi-

tive advantage resulted from computer usage.

Mr. Golub studied 100 companies in 11 manufacturing groups. He made a correlation analysis between each company's total investment in computers and four performance measures: return on assets, return on sales (profits), sales per employee, and earnings per share growth over the past ten years. The resulting correlation coefficients were either zero or slightly negative, indicating no direct relationship between computer investment and the four performance measures.

Though it was predicted that computers would change management styles, Mr. Golub said that little change has occurred.

Panelists predicted that in the next 25 years the data processing industry will realize economies of scale for mass products; the costs of computer hardware will become inconsequential; and new applications will be developed.

"Opportunities will be many and so will failures, but—one thing for sure—any competitor who tries to remain within one of the traditional subdivisions of the computer industry, however large, will be lucky if he is around in 25 years," said Frederic G. Withington, senior staff associate of Arthur D. Little, Inc.

Hewlett-Packard Says Automatic Test Systems Are Effective

Computerized automatic test systems are cost effective when properly applied and where sufficient volume of data is available, David S. Kline told the Western Electronic Show and Convention August 25.

Mr. Kline is a program manager with the Hewlett-Packard Automatic Measurement Division. His statement was based on a detailed review of three case histories: production testing of telephone electronics, thin-film substrates, and digital cards.

Reviewing the three cases, Mr. Kline noted that "computerized test systems require support. In all three systems there was a competent, dedicated technical person actively writing programs, solving unforeseen problems, and generally adapting the system to the tasks."

User participation vital

"The system cannot merely be purchased and go to work, but requires participation of the user. The requirement for such support will continue for the life of the system as long as there are changes in products and processes," he cautioned.

Mr. Kline believes that the automatic test systems not only can make measurements faster than they could be made manually but they also measure products and processes where testing would not

have been economically feasible without the computer.

"Another area of promise," Mr. Kline told the convention, "is the improvement in product assurance made possible by automatic testing. The high speed, accuracy, and repeatability of computerized tests makes feasible more testing on low-unit-priced products."

Tool Company Reports Good Results from Automated Scheduling

According to officials of the Radform Tool Company, East McKeesport, Pa., a computerized production scheduling and reporting system is helping the company to make more effective use of existing production capacity besides maintaining control of operations and establishing work priorities.

Bob DiBiase, Radform vice president, said, "The addition of another man, devoting his time to handling the scheduling and expediting of work, could not give us as much information as the computerized system and he would cost more per year."

The scheduling and report system was designed to help Radform overcome problems that commonly arise from the use of expediters in a shop. The tendency is for regular scheduled jobs to be overlooked until they too become critical and must be expedited. The situation sometimes deteriorates into filling the most critical order first.

Radform is now using a system developed by the Westinghouse Tele-Computer Systems Corporation. Job order routing slips, time tickets, and material data sheets are fed into the system. The system then generates a weekly machine load report, a production scheduling work sheet, a job status report, time reports, and a job closeout report.

Radform has reduced its backlog of semifinished work on the shop floor and lowered its operational costs with the help of the computerized scheduling and reporting system.

PERT, Critical Path Analysis Offered on Time Sharing Basis

A project planner can now perform critical path analysis by means of a conversational terminal in a new service offered by Scientific Time Sharing Corporation, Washington, D.C.

In the critical path method the planner defines the time relationships among those activities and events which will govern completion of the project. The advantage of employing an interactive approach to planning is that all the data used are current. Changes in the PERT network are entered into the computer at the time they occur.

Traditional method slow

"Using the traditional batch processing approach, the data go through keypunching, transmittal to the computer center, computer processing, correction of errors, reprocessing, and distribution of the calculated critical path schedules," Scientific Time Sharing explains. "Typically, by the time these steps are taken, some of the data no longer represent the current status of the project."

Using STS's conversational terminal, the planner types 'CALCULATE' and a recalculation of the critical path is performed. Time relationship diagrams can also be obtained on a standard terminal. The results may then be directed to other terminals at the locations where action must be taken.

Local dial access to Scientific Time Sharing's service is available in Buffalo, Dallas, Hartford, Los Angeles, New York, Palo Alto, Philadelphia, Pittsburgh, Rochester, San Francisco, Washington, White Plains, Baltimore, Boston, Chicago, and Stamford. Customers outside these cities can make a long distance call to the closest point of access. Scientific Time Sharing Corporation is located at 2135 Wisconsin Avenue, N.W., Washington, D.C. 20007.

IRS Preparing to Clarify Tax Treatment Of EDP Software

The Internal Revenue Service is drafting a bulletin which clarifies tax treatment of purchased software, the Data Processing Management Association reports after a recent meeting with IRS officials.

Contained in the bulletin will be the criteria which will differentiate between outside software services which can currently be expensed as developed software and outside services which must be treated as purchased software capitalized, the DPMA says.

The IRS officials met with DPMA representatives after receiving a telegram from the data processing organization. The telegram registered the DPMA's concern over a report that the IRS was considering the issuance of a ruling to the effect that all systems engineering and programing service payments to outside organizations would be considered "purchased software."

As the DPMA interprets this ruling, under Revenue Procedure 69-12 a taxpayer would be required for tax purposes to capitalize all software costs paid to outsiders and write them off over a five-year period. Yet the cost of "internally developed software," representing primarily the time of the taxpayer's employees, could be deducted as current operating expense.

Consequently, the DPMA feared that tax treatment would be solely based on whether the software services in question were performed by consultants, service bu-

reaus, software houses, facility management concerns, and the like.

However, after its meeting with the IRS the DPMA reports that it feels the government agency is sympathetic to its concerns and it hopes that the IRS's final determination will be beneficial to the data processing industry and profession.

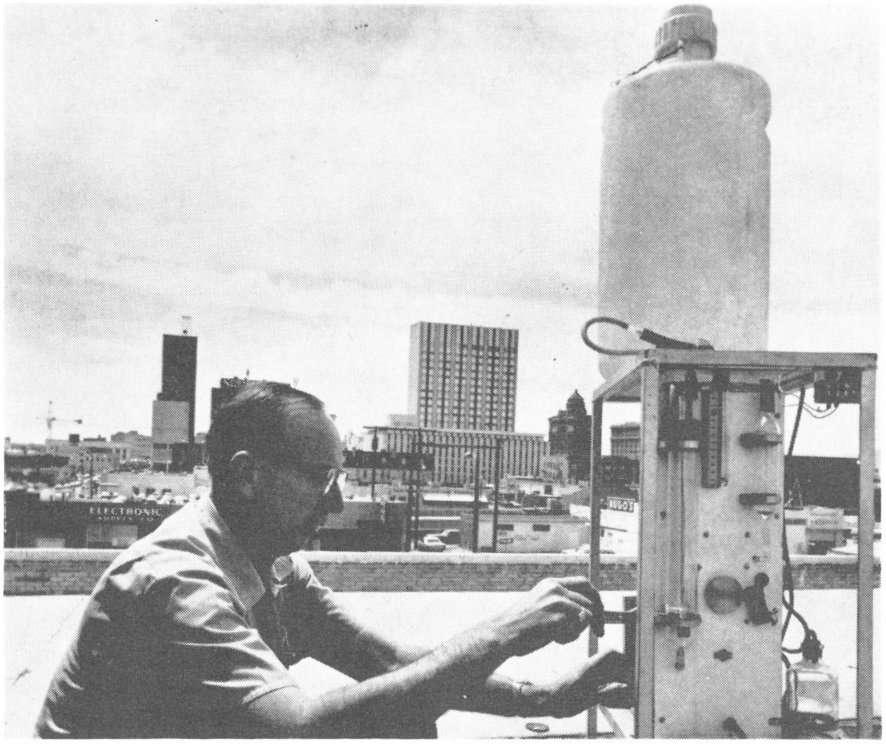
Arthur Young Aids Drug Agency In New York City

Accountants from the New York office of Arthur Young & Company have volunteered their services to work with New York City's Addiction Services Agency.

Addiction Services Agency Commissioner Graham S. Finney explained that many of the contract agencies the New York drug program works with are dealing with governmental agencies for the first time and, therefore, may have neither the funds nor the experience to establish proper accountancy procedures as required by law. New York State's Youthful Drug Abuser Program works with 104 of these contract agencies.

The A.S.A. is "lending" the volunteer accountants to delegate agencies. On the volunteer's initial visit to an agency he determines if any problems exist in the accounting area. He then proposes what he feels is the best method for solving any problems and for keeping records in compliance with the A.S.A.'s fiscal requirements. The volunteer will make periodic visits to the agency to ascertain the compliance and makes himself available at other times when problems arise.

"This effort came on the initiative of Arthur Young & Company itself," Commissioner Finney said. "The program is proving so successful that we are in process of contacting other large accountancy firms to augment this splendid effort mounted by Arthur Young & Company."



Readings are taken at one of the 18 ground-level sensors used in El Paso to keep constant check on the quality of the air. The system warns American Smelting and Refining Co. when to curtail operations to prevent excessive concentrations of sulfur dioxide in the atmosphere.

Quality of Air Continually Monitored in El Paso by Computer Fed by 18 Sensors

A computing system warns American Smelting and Refining Co. when to curtail or stop its operations to preserve the air quality of El Paso, Texas.

Eighteen sensors are placed around El Paso, some in residents' backyards, to detect concentrations of sulfur dioxide, a gas by-product created during copper and lead smelting. The sensors transmit their readings to an IBM 1800 data acquisition and analysis system at a nearby American Smelting and Refining Co. (ASARCO) smelter.

The computer determines how much sulfur dioxide is reaching ground level. Minute-by-minute concentration reports are made to the ASARCO meterologists. When the concentrations approach the lowest air quality control limit ASARCO must maintain, operations are curtailed or stopped.

To improve the air quality in the future ASARCO is now developing a mathematical model of El Paso's atmosphere. Years of El Paso's weather history are being fed into the company's computer so that ultimately ASARCO officials will be alerted to which weather trends cause a buildup of sulfur dioxide at ground level.

"We started with the mathematical model for diffusion of a gas into the atmosphere," said W. R. Kelly, ASARCO plant manager. "The model is being adapted for variations we have here: differences in temperature, terrain and wind patterns, temperature inversion over the city, and even small differences in the behavior of this particular gas.

"Using the computer simulation technique, we will be able to predict whether the smoke will reach ground level in bothersome concentrations or will diffuse harmlessly in the atmosphere over the surrounding desert," Mr. Kelly said.

Victims Strike Back At Polluting Companies Through 'Ecotage'

The nation's first "ecotage" contest is underway and polluting industries should beware.

The *Wall Street Journal* reports that ecotage means sabotage for ecological reasons, which includes mailing garbage to executives of polluting firms.

The Environmental Action lobby is the contest's sponsor. Sam Love, the group's coordinator, told the *Journal*, "We want citizens to submit ideas for stopping corporations or other institutions from polluting, exploiting, or otherwise threatening the survival of the earth and its inhabitants."

The U.S. Chamber of Commerce has issued a press release to let industry know about the perils of the ecotage contest and has even made available a compilation of tactics the infuriated ecologists might try to use to disrupt business.

In the past, air polluting factory stacks have been capped, and effluent has been thrown on a steel executive's rug by an individual who dubbed himself "the Fox." Consequently, the prize for Environmental Action's ecotage contest is called the "Golden Fox" trophy.

One eloquent contestant suggested oil company executives have "oil saturated carcasses of murdered seabirds" placed in their mailboxes. Pity the poor secretary who has to figure out what to file that under.

Former AMA Executive Offers Training Program Assistance

Companies that wish to sponsor public seminars or internal managerial training programs are being offered the professional planning assistance of a new organization, Executive Enterprises, Inc., New York.

The new company's president is Lewis Abrams, a former director and vice president of programing for the American Management Association.

"Many meetings are time wasters and people often attend for all the wrong reasons," Mr. Abrams said. "With careful planning, however, seminars can be highly beneficial and profitable since group members, when properly motivated, will reinforce one another in promoting changes in corporate attitudes and behaviors."

Executive Enterprises, Inc., also offers consultation and direct assistance on corporate marketing and administration projects. The company is located at 253 East 72nd Street, New York, N.Y. 10021.

Clerical Cost Control Booklet Announced By Consultant

What an Executive Should Know About Controlling Clerical Costs, a booklet by Richard L. Ganzi, is being offered free upon request to his management consulting firm.

Mr. Ganzi, president of Paul B. Mulligan & Co., Inc., Scarsdale, N.Y., writes, "The key to effective office supervision lies in altering the role of the supervisor as it applies in the average company today."

Some steps he recommends for bringing abont this change are: Optimize span of control; consolidate departments; give special treatment to high-skill functions; upgrade the supervisory level; keep information pipelines open; give supervisors the tools they need to function effectively; and work in meaningful incentives.

"Today's average 'working supervisor' is overpaid," Mr. Ganzi says. "Yet the managing supervisor who replaces him may merit an even higher rate of pay because you are now buying, not a clerk, but a manager. The point, of course, is that in the end the company stands to gain."

Mr. Ganzi's booklet can be obtained by writing to Paul B. Mulligan & Co., Inc., 2 Overhill Road, Scarsdale, New York 10583.

Hitachi Shows New Memory System with Increased Capacity

A new memory system capable of storing all of the information in one volume of the Encyclopaedia Britannica, approximately 10,000,000 characters, in an area equivalent to the surface of two postage stamps has been developed by Hitachi, Ltd., Tokyo.

Capacity 10 times any other unit

The holographic memory system has a storage density of 100,000 bits per square millimeter. Hitachi says this is about ten times more than memory devices previously announced and about 1,000 times more than integrated circuit memory systems.

Hitachi's memory system employs information-bearing laser beams which are diffused through a multi-layered cerium oxide plate called a "random phase shifter." Reading of the stored information is achieved by throwing a laser beam on the holographic memory. The reading time is 10,000 to 100,000 times faster than that achievable with a disc memory, Hitachi claims.

Computer use foreseen

Possible applications for the Hitachi system are for high-speed image file memory in information retrieval systems and for large-capacity high-speed computers, according to the company.

NCR Shows New Communications Unit Faster than Teletype

The Teletype machine has a new competitor from the National Cash Register Company. It is the NCR 260 Data Terminal, an on line communications device for linking computer centers with remote installations.

"The NCR data terminal can best be compared to a Teletype machine," said R. E. Rabold, NCR's manager of Product Requirements for Accounting Machine Products. "They both serve essentially the same function. The 260 just does it faster and more economically. It is also quieter and smaller, important factors in a bank and office."

The NCR terminal uses thermal printing, which, NCR claims, is faster than impact printing, the method used by the Teletype machine. In impact printing the struck keys have a finite recovery time, NCR notes. However, the 260's printing is done with a single-element head that projects bursts of heat onto paper coated with a heat-sensitive dye. The heat activates the dye to change color on the paper. The result is faster and quieter printing, NCR says.

According to Mr. Rabold, NCR originally thought of the 260 as a remote communications device linked to a computer, suitable for bank tellers, for example. However, NCR has now realized its terminal's potential for transmitting news. The firm reports both the Associated Press and United Press International have ordered units for test runs in news transmission.

The 260 is compatible with the Teletype machine and most hardware manufactured by the major computer makers. It requires no special software, the company says.

NCR spokesmen did concede, however, that the 260 will not work from punched paper tape or make multiple copies as the Teletype machine will.

Long-range diagnosis is foreshadowed by the IBM Computer-Assisted Medical Examination System. In response to filmed questions, the patient indicates exactly on the dummy shown on the screen where he feels pain by touching the spot with a light pen. Actually, the system is used for preparation of medical histories rather than remote diagnosis; responses are fed to a computer which summarizes the patient's history.

Honeywell Expands Its Series 100 Line by Adding Two Batch Terminals, Free-Standing Computer

Two new batch terminals and a small-scale, free-standing computer have been added to Honeywell's Series 100 family of computers.

The two terminal systems, called Model 5 and Model 10, use punched card input and can print reports when attached to a computer. The terminals can be expanded to provide either pre-processing of data prior to transmission or local batch processing for jobs not requiring use of the central system.

Both terminals are available in standard and high-speed versions. The standard Model 5 leases for $838 per month on a five-year contract and sells for $37,440. The high-speed Model 5 leases for $1,164 per month on a five-year contract and sells for $52,000.

The Model 10 has a central processor with a main memory, 8,192 bytes, twice as large as that of the Model 5. The standard Model 10 leases for $1,794 per month on a five-year contract or can be purchased for $82,205. The high-speed Model 10 leases for $2,027 per month on a five-year contract and sells for $92,865.

Honeywell's new free-standing computer with communications capability, the Model 15, can be used as a central system linked to the Model 5 and Model 10 terminals. It can also act as a large remote batch processing terminal linked to other large computer systems.

According to Honeywell, the Model 15 is well suited for disk-oriented batch data processing systems used by firms in manufacturing, distribution, education, retailing, and insurance and by hospitals and government agencies.

Its central processor contains 16,384 bytes of main memory. Options include additional memory modules.

The basic minimum Model 15 configuration leases for $2,821 per month on a five-year contract and sells for $132,585.

Software available for the Model 10 and 15 includes accounts payable and receivable, payroll, inventory management, and production scheduling for manufacturing firms.

BankAmericard Institutes Uniform Profit Analysis System for All Members

The performance of BankAmericard operations will be measured by a new profit analysis system.

The system was announced after a wave of unfavorable publicity about the operations of many bank credit card systems.

National BankAmericard Incorporated is giving its member banks a standardized method of allocating and reporting income and expense. The method was developed under the direction of Charles E. Hamel, NBI vice president, and Arthur Andersen & Co.

Data consistent for members

The system was designed to: categorize income and expense items and related statistics in order to provide consistent data for individual member bank use in analyzing performance of their BankAmericard Centers; enable banks to determine the direct profit or loss of their individual card programs; provide NBI with accurate nationwide data for statistical analyses; and provide for the development of more sophisticated financial tools.

Member banks will receive quarterly analyses highlighting the financial characteristics of various types of BankAmericard programs.

The first phase of the system was installed in June.

Westinghouse Systems Offer New Inventory Control System

The Westinghouse Tele-Computer Systems Corporation has introduced an inventory control system that provides three general kinds of services.

First, the system tells the planner the amount of material in store, and when and how much to order.

Second, the system produces control reports that highlight capital tied up in excess stocks, surplus and inactive stock, service analysis, etc.

Finally, the inventory control system provides financial data which satisfy basic accounting requirements.

The inventory control system can either stand alone or interface with other information processing systems.

More information is available from the Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh, Pa. 15230.

Time Sharing Parlor Game Introduced by Indiana Manufacturer

Would-be computer entrepreneurs are now getting a chance to test their marketing skill with a new parlor game called Time-to-Share. Those businessmen who have always been losers in Monopoly may perhaps find this their game, or next venture.

Time-to-Share can be played with from two to six players ten years old and up. The players set up their own time sharing companies from computer system components and then try to market their services to 32 businesses. A player wins when he can establish an operation profitable enough to enable him to repay his original financing of $500,000.

"Time-to-Share was designed to present a complete and accurate picture of the procedures required to set up and run a time sharing operation," explains the game's manufacturer. So players first do market research and then select their system components to fit their potential customers' needs.

'Systems' leased from 'bank'

Each player leases his system from the bank. Remote terminals are provided to players in accordance with the support capabilities of their total system.

In order to derive monthly income from his business operation a player must complete sales to customer prospects and install terminals. Each time a player circles the board, representing a month of business operation, he receives leasing fees.

The time sharing game is being produced and marketed at $9.95 by Time-to-Share, 4606 Charlestown Road, New Albany, Indiana 47150.

If this game catches on, one can predict a whole string of games created to mirror different enterprises, management consulting firms, hospitals, brokerage houses. To paraphrase the Bard, all the world's a game and all the men and women merely players.

Honeywell Offering Production Control, Scheduling Systems

Two computerized scheduling and control systems for manufacturing firms have been developed by Honeywell for its Series 100 and Series 200 computer users.

The systems are designed to provide production scheduling, loading, control, and reporting capabilities for a wide variety of manufacturing operations, Honeywell says.

According to Peter J. Sheridan,

director of industry marketing for Honeywell Information Systems, U.S. group, benefits of the systems include: reduction of manufacturing cycle time; increased reliability in meeting shipment dates; rapid determination of inventory valuation and order status; reduction of raw, in-process, and finished inventories; and timely, accurate performance data for measurement and control.

Production Scheduling and Control System I, for small computer systems in both Series 100 and 200, has a minimum rental of $2,740 per month on a five-year contract. Production Scheduling and Control System II, for medium-size Honeywell computers, has a basic rental of $8,840 per month on a five-year contract. Deliveries start in the fourth quarter of this year.

Software Costs Now Higher than Hardware In Computer Budgets

"Computer software has already overtaken hardware in the nation's EDP budgets," reports the New York research firm of Frost & Sullivan, Inc.

The firm notes that the market for outside software and services exceeded $1.6 billion in 1970. Frost & Sullivan predicts that by 1975 the market will pass $3 billion and will reach $5.6 billion by 1980.

Despite the delays in some expected software market expansion, caused by recent economic conditions, renewed growth is expected in most areas, the research firm finds.

These observations are part of Frost & Sullivan's new analysis and forecast report called *The Computer Software and Services Markets.* It sells for $345.

Some of the subjects discussed in the report are: the move toward packaged software; the effects of unbundling; the emerging standardization of large data bases; and the specialist software markets.

More information about the report may be obtained from Frost & Sullivan, Inc., 106 Fulton Street, New York, N. Y. 10038.

Format Conversion Service Launched By PDA Systems

A computer service to convert any existing data file into any user-defined format has been started by PDA Systems, Inc., New York.

The new service, called UNIVERSE, has already enabled two direct mail concerns to obtain mailing lists from any vendor, without respect to tape format, mode, or density, PDA Systems says.

UNIVERSE can not only perform format conversion, but it can also handle files which require additional or special processing, PDA states. Records can be selected from the file by UNIVERSE on a percentage basis or based upon the value of any field within the record.

A tape of rejected records with the reason for each rejection is provided the subscriber.

PDA Systems, Inc., 12 East 86th Street, New York, N.Y. 10028, charges $1.25 per thousand records processed by its UNIVERSE service. There is an additional $150.00 charged to set up each file. A surcharge of $45.00 per reel is added for all tapes other than 9-track 800 bytes per inch.

Boeing Offers Program to Give Tenant-Management Data to Housing Officials

Local housing authorities can now be provided with tenant and management accounting and reporting via a family of computer programs being marketed by Boeing Computer Services, Inc., Seattle, Wash., and Management Data Systems, Madison, Wis.

The programs comprise a computer-based management system which fulfills basic tenant and general-ledger accounting requirements prescribed by the U.S. Department of Housing and Urban Development. The system also provides information for more than 20 periodic reports required by HUD, its marketers say.

The system will be offered to local authorities on an on line teleprocessing basis from BCS and MDS data centers across the country. There are more than 3,000 local housing authorities in the United States, Boeing notes.

Boeing is also offering a family of programs to solve another urban problem, solid-waste collection (see M/A July-August '71, p. 13).

NCR Announces Package Program For Data Analysis

Users of cash registers, adding machines, and accounting machines can now obtain analysis and distribution reports without requiring customized programing, NCR says.

NCR's 40 data centers are offering a new service called General Analysis Program (GAP) which gives its users "the capability of high-volume sorting and summarizing," the firm states.

The program is primarily designed to use punched paper tape as input but it can also use optical-font tapes.

According to NCR, GAP can do inventory work, job costing, sales analysis, purchase and expense analysis, labor distribution, budgetary reporting, manufacturing and equipment maintenance costing, and accounts receivable and accounts payable aging.

First users of GAP include a light-fixture company that is receiving sales analyses by customer,

state, and product and a vending machine service which, using adding machine punched tape, is getting sales analyses by location and product user besides sales by product, NCR reports.

New Communications System for Police Eases Radio Crowding

A patrol car driver can report the location and status of his vehicle in less than one second by touching a pressure-sensitive map that is part of a new electronic system developed by GTE Sylvania Incorporated, New York.

Channel congestion reduced

The new system, Digimap, reduces radio channel congestion by sending messages in quick tone bursts rather than by voice, GTE Sylvania says. Digimap is designed for use with existing GTE Sylvania communications equipment.

Vehicle terminals have a pressure-sensitive map mounted on a grid-coordinate board and a keyboard with a small video screen for sending and receiving messages.

At headquarters the dispatcher's map has color-coded indicators which flash on his situation screen to mark each vehicle's position as it reports in.

Pre-selected messages, such as "send ambulance," can be sent by the drivers by simply pressing a button.

Workload analysis possible

Each digital transmission can be stored on magnetic tape and later analyzed to determine what workloads should be set and how vehicles should be deployed, GTE Sylvania says.

Digimap equipment is scheduled for installation for the Oakland, California, police department in October.

Computer Making Stock Recommendations Cued To Short-Term Traders

Traders in stocks listed on the New York Stock Exchange can now have a computer help them make their buy-or-sell decisions. Computrader, Inc., of Dallas will send its subscribers approximately 130 advisory bulletins each year containing its IBM unit's prognostications.

Every other day a Computrader IBM computer scans each common NYSE stock and reports on issues which seem to show specific promise for short-term gain. Within three hours after the close of the market every other day Computrader sends its subscribers a computer printout of its predictions.

According to George C. Burrell, Computrader president, the printout provides buy and sell signals and helps the investor to manage his money by moving in and out of stock positions when the computed odds mathematically favor such movement.

Gerald Tomanek, a Dallas stockbroker, developed the technical market formula upon which Computrader is based. He explained, "Computrader advice is aimed at making the largest possible profit in the shortest possible time. It can help the long-term investor with timing, but is basically designed to show the short-term trader areas of greatest activity."

The service sells for $275 per year from Computrader at 5615 Daniels, Dallas, Texas 75206.

Minicomputer Users Offered New Package For Accounts Payable

Small and medium-size businesses are being offered an automated accounts payable software package for use with the Philips P-350 series of minicomputers.

According to Arthur L. Hanrahan, president of Philips Business Systems Inc., the software package contains all routines necessary for posting vendor and distribution ledgers, preparing vouchers and checks, and compiling complete management reports.

The system employs vendor ledger cards which contain a magnetic stripe storing the name, address, identification code, current balance, and year-to-date balance. This permits automatic entry of data that are usually entered manually, Mr. Hanrahan said. "The saving in labor time and the virtual elimination of losses through human error are enormous advantages," he said.

The automated payment function is initiated by inserting a standard voucher check and the vendor's ledger card. The check receives the information stored on the magnetic stripe of the ledger card including applicable discounts.

A daily total sheet of debits, credits, discounts, and checks written is produced as a by-product of the system's operations.

Philips Business Systems Inc., New York, is a subsidiary of the North American Philips Corporation.

Accounts Receivable Service Is Available For Small Businesses

Companies that produce between 100 and 500 invoices a month are being offered a new computerized accounts receivable service by the Data Processing Division of ITEL Corporation.

The "Mini Account" service includes preparation of statements ready for mailing and ledger cards.

ITEL's Mini Account service costs $300 for the initial set-up and then a minimum of approximately $150 a month, based on the number of invoices generated.

Petty Larceny? It May be Good, Advises Psychologist

One large New York City clothing store recently instituted lie detector tests for its employees. Of course, the workers' union reaction was strong, and eventually, after much notoriety, the tests were dropped. Perhaps this entire confrontation could have been avoided if the store's management had realized the "benefits" of employee theft, as argued by Dr. Lawrence R. Zeitlin in an article which appeared in the June issue of *Psychology Today*.

Entitled "A Little Larceny Can Do a Lot for Employee Morale," Dr. Zeitlin's article appeared in *Psychology Today* after being rejected by the *Harvard Business Review*. *HBR's* senior associate editor, David W. Ewing, explained in a letter to Dr. Zeitlin, "To be perfectly frank, the consensus is that your conclusions—especially the idea of a tolerable amount of theft—aren't consistent with the ideals of *HBR*."

Dr. Zeitlin, an industrial psychologist and professor of industrial psychology at the City College of New York, concludes that in some cases employee theft may be an informal, and relatively inexpensive, form of job enrichment.

"I do not advocate abandonment of the traditional responsibilities of management, but I suggest that management adopt a more realistic and certainly less hypocritical attitude to business 'honesty' and publicly recognize that there is benefit to be obtained by utilizing employee theft as a motivational tool," Dr. Zeitlin writes.

Dr. Zeitlin may be one of the first to come out and say what many businessmen have suspected all along. He recounts the experience of a friend of his who reported to a company president that his office manager was dipping into the petty cash at the rate of approximately $2,000 a year. The president then asked the friend how much the manager was being paid and was told $10,000. "Then keep quiet about it," said the president. "He's worth at least $15,000." One wonders what the friend's expression was like at that moment.

Employee theft is the result, in part, of management's failure to alleviate the repetitive and boring nature of low-level retail jobs, Dr. Zeitlin feels. Management can either enrich jobs or increase worker pay and benefits, but in most cases, the psychologist finds, management has chosen to reject both approaches. Consequently, if the dissatisfied employee does not quit he gets back at the system by stealing.

During a two-year study Dr. Zeitlin interviewed 32 persons who were discharged from a large Midwestern clothing store for stealing. Six stole for impulsive reasons, but he believes that the other 26 might have had their thievery minimized if management had provided job enrichment or salary increases.

"But would this have paid off for the employer?" Dr. Zeitlin asks. And his startling conclusion is no. "The dishonest worker is enriching his own job in a manner that is very satisfactory (for him). The enrichment is costing management, on the average, $1.50 per worker per day. At this rate, management gets a bargain. By permitting a controlled amount of theft, management can avoid reorganizing jobs and raising wages," he writes.

Dr. Zeitlin suggests that management should ask itself four questions before it decides to minimize or eliminate employee theft: "1—How much is employee theft actually costing us? 2—What increase in employee dissatisfaction could we expect if we controlled theft? 3—What increase in employee turnover could we expect? 4—What would it cost to build employee motivation up to a desirable level by conventional means?"

While Dr. Zeitlin's proposal may save the jobs of some sticky-fingered retail workers, it could cost a few security experts (as well as industrial psychologists) theirs.

We gave each student 6 matches, a fishhook, some string and three days alone on an island.

Here's what they gave us:

I stood on my island and screamed
"Who in hell am I?" No answer came
from the cold sea.

I hated it and I loved it and in the end
I made it through. Hallelujah!

The struggle was beautiful.

During World War II, the British discovered that younger seamen were less able to survive the ordeals of shipwreck than their older mates. The younger men, it seemed, were giving up sooner under extreme hardship. So a school was set up to teach survival techniques and build, through experience, the tenacity necessary to withstand severe stress.

That was the beginning of Outward Bound. Today there are schools all over the world with seven in the U.S. These are wilderness schools, but they teach more than merely how to survive in the wilderness. Their purpose is to help each student plumb the depths of his capacities by placing him in situations where he discovers that he can accomplish far more than he dreamed possible. Further, students learn, through helping each other under stress, a new regard for each member of the crew and a genuine sense of teamwork.

Outward Bound has courses for young men, girls, adults, co-ed courses and special seminars for management and teachers. It is non-profit, financed by private grants, contributions and tuition charges. Over half the students attend on full or partial scholarships. You don't have to be an athlete or have any special skills to attend Outward Bound. We'll teach you everything you need to know.

If you'd like to know more about it, or you want to help someone else attend, write Outward Bound®, Inc., Reston, Virginia, or one of the schools listed below.

Northwest Outward Bound School, 3200 Judkins Rd., Eugene, Oregon 97403. Minnesota Outward Bound School, 330 Walker Ave. South, Wayzata, Minn. 55391. North Carolina Outward Bound School, P.O. Box 817, Morganton, N.C. 28655. Hurricane Island Outward Bound School, Concord, Mass. 01742. Colorado Outward Bound School, P.O. Box 7247 Park Hill Station, Denver, Colo. 80207. California Outward Bound School, 780 Welch Rd., Suite 203, Palo Alto, Calif. 94304. Texas Outward Bound School, 4422 Live Oak St., Dallas, Texas 75204.

Outward Bound
Schools of The Possible

Major trends for some time have indicated the importance to management of specific marketing measurements and plans. Now the cost-price squeeze has accelerated the movement toward —

DOWN-TO-EARTH MARKETING INFORMATION SYSTEMS

by Neil Doppelt
Arthur Andersen & Co.

As THE cost-price squeeze continues to handicap many companies, increasing attention is being paid, not only to every effort to cut costs but also to every possible way to increase sales and profits. This has focused attention on marketing efforts—and marketing management—as it has never been directed before.

The accountant, whether he is internal or external, has a vital role to play in this increasing attention to marketing activities.

This concentration, while it is rather belated in some companies, is only an acceleration of trends that have been visible for some time.

Actions to improve the management of marketing activities and to increase senior management's understanding of marketing functions have been prompted by three key factors:

1. More companies are adopting a definition of marketing operations that goes beyond the simple mechanics of selling products to consumers. This "marketing concept" begins when the company interprets the consumer's needs and desires, both quantitatively and qualitatively; follows through with all the business activities involved in the flow of goods and services from producer to consumer; and ends with those services necessary to aid the consumer in getting the expected utility from the products he has purchased. In order to adopt the marketing concept in deed as well as word, companies must approach the market place with respect and flexibility, rather than trying to succeed with brute force.

2. Investments in advertising, sales promotion, market research, salesmen, and new product development are increasing. Possible profit improvements by making

more effective use of marketing resources are often much larger than the prospects of achieving significant product cost reductions.

3. The outputs of the marketing department are critical to orderly and efficient operations throughout the organization. Marketing forecasts and budgets become the basis for production schedules, cash flow projections, and profit plans. Conversely, lack of detail, accuracy, or timeliness in marketing planning can impair the profit potential for products or services that are otherwise strong and competitive.

Past neglect—why?

If marketing is so important, why do many companies find themselves with fragmented or nonexistent planning and control systems in this area? Several reasons can be pinpointed:

- Partially by design and partially by accident, marketing often becomes isolated from other operating departments. Senior executives accustomed to dealing with straightforward information about machine hours, inventory turns, and sales volume are reluctant to dig into the supposedly less precise areas of marketing decisions. In some cases marketing managers themselves have contributed to this situation by overemphasizing subjective judgment as the basis for their strategies—even though most marketing executives are at least as fact-oriented as their counterparts in other functions.
- Marketing information needs have usually been satisfied on a piecemeal basis by using data sources and reports really designed for other management purposes, such as financial reporting, production control, and accounting. This "hand-me-down" method sometimes looks like an economical way to solve continuing marketing information problems. Basic information needs go unfulfilled, however, since important aspects of customer identification, cost allocations, and external market conditions cannot be captured unless special provisions are made for doing so.
- EDP techniques have been successfully applied first where dollar savings or operating advantages have been easily recognized; accounting, inventory control, order entry, and production scheduling usually get top priority. The benefits of better information for the marketing function are difficult to quantify in dollars and cents.
- The concepts behind a marketing information system may be misinterpreted by senior executives. At one extreme, they may expect such systems to deliver the answers to the most difficult kinds of questions—the effectiveness of advertising and promotion, for example. At the other extreme, the systems approach may be dismissed as just another sales reporting scheme. Neither concept is correct. As is detailed in this article, many problems can be solved or their current solutions improved upon with better marketing information. Imperfect answers to tough questions are usually better than no answers at all, and sales reporting is only one element of a basic system.

When the pressures to develop effective systems for marketing become great enough, these historical problems succumb to good management judgment and a "marketing information system" begins to sound like the right answer.

The primary objective of a marketing information system is to improve marketing management's ability to identify profitable sales opportunities, to make the most effective use of sales force personnel, to allocate advertising and sales promotion expenditures efficiently, and to react quickly and correctly to changes in market conditions. The "system" itself can be broadly defined as an organized set of procedures, information-handling systems, and reporting techniques designed to provide the information needed to plan and control marketing activities.

These definitions of objectives and system content are necessarily long because a substantial amount of information is required to manage the marketing function and there are many different kinds of tasks carried out within that function. Regardless of the eventual complexity of a marketing information system, the guiding philosophy is simple: Better information helps capable men do a better job.

A good problem solver usually has the answer sketched out in his mind before he sets to work. The same logic applies to the design of a system to meet the information needs of marketing management—the most important information needs should be anticipated before the first interview is scheduled. The following list is offered as a guide to the kinds of information marketing managers want, whether the products involved are building materials, breadsticks, or bonds:

Customer information

- Where is volume concentrated?
- Who are specific major cus-

NEIL DOPPELT is a manager in the Administrative Services Division of Arthur Andersen & Co. in New York. Formerly he was a senior marketing analyst with Esso International, Inc. Mr. Doppelt received a B.S. in chemical engineering from the Massachusetts Institute of Technology and an M.S. in industrial administration from Carnegie-Mellon Graduate School of Industrial Administration.

tomers, both present and potential?

- What are their needs for products?
- What are their needs for sales coverage and service?
- What order activity and volume are expected?
- What are the differences in profitability between types and classes of customers?
- Where is performance significantly short of expectations?

Product information

- What are the relative profitabilities of products at the gross margin level? After direct marketing expenses?
- Which elements of variable product cost are influenced by marketing decisions? What is the current cost structure?
- Which products tend to respond most favorably to sales promotion at the wholesale, retail, and consumer levels?
- What are the major advantages and disadvantages of current products in the eyes of consumers, relative to competitive products?
- What factors have the greatest influence on sales volume?
- What is the status of volume and profitability relative to objectives?

Sales force information

- What area and which customers are assigned?
- What call activity is required, both for protection of present volume and development of new business?
- Do current compensation systems motivate the desired mix of salesmen's activity?
- What is current performance relative to objectives?

This list can be expanded, of course, into the detailed questions concerning the "right" strategies for pricing, advertising, sales promotion, and new product development. However, information systems do not make strategic decisions—managers do, by the best use of their experience and the information and analytical tools available to them.

A basic marketing information system should be designed to provide most or all of the customer/product/sales force information listed above. Focusing on the *decisions* each manager must make as part of his normal job responsibility helps to define what his information requirements are and how his outputs of plans and forecasts can best be integrated into the information system.

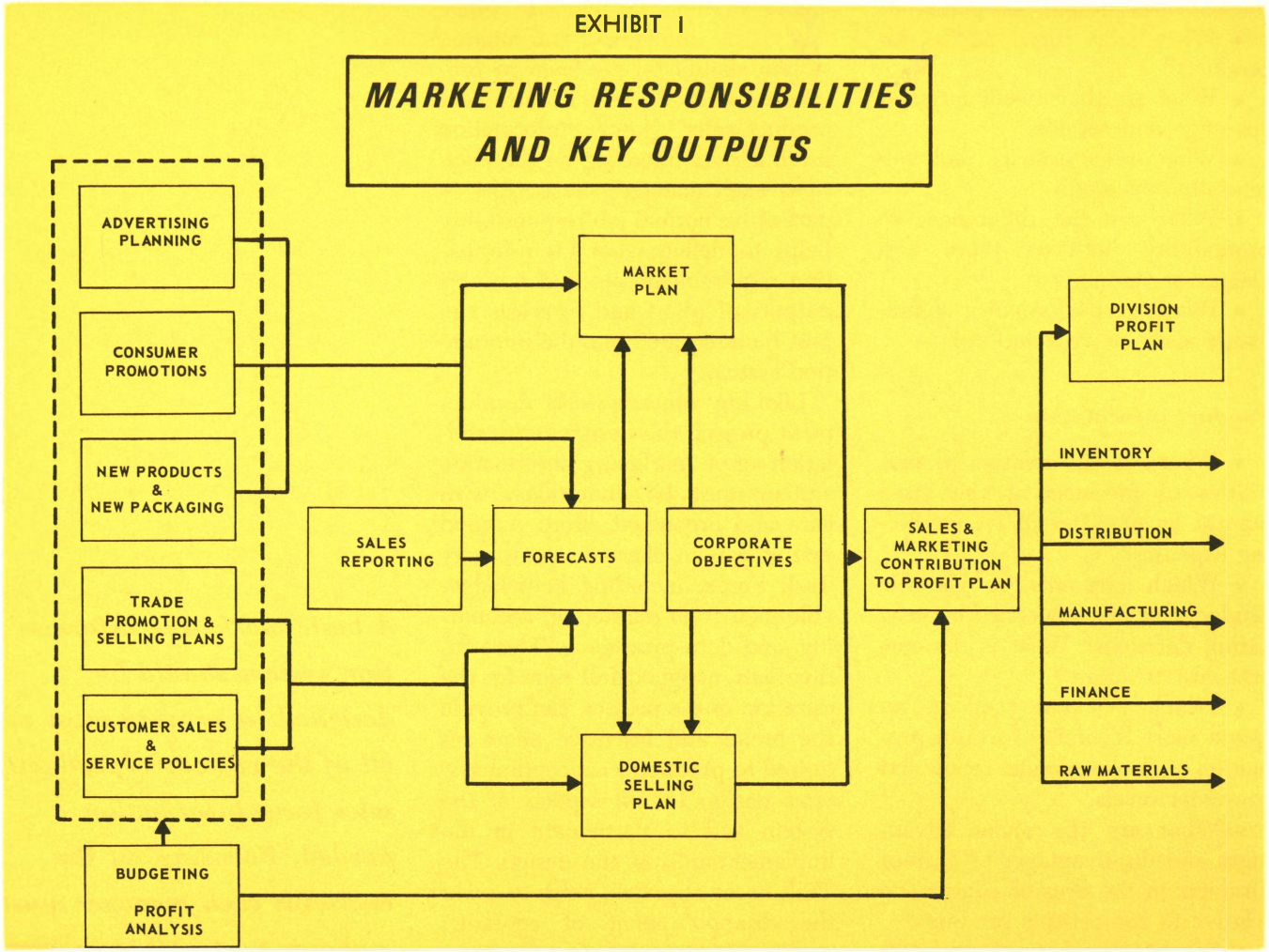
Like any other systems development project, the design and installation of a marketing information system must be undertaken with care and organized effort. A good first step is to charter a temporary Task Force, including knowledgeable men from marketing, accounting, and data processing. These individuals, assigned full time for the duration of the project, can provide the broad and intensive effort required to produce a conceptual systems design for all aspects of the system and to participate in the implementation of the design. The Task Force approach helps to avoid the disappointment of sporadic, stop-and-start marketing systems projects.

Varied skills required

Each member of the Task Force can make important contributions to the project. The marketing representatives (there could be more than one) should have overall responsibility for the successful completion of the project. The system will be designed, after all, to meet the needs that they identify and interpret. The accounting representative's skills will be needed because accounting systems in particular are likely to require revision in order to accommodate marketing information needs. The data processing man should participate in the planning of changes in data collection and reporting systems, as well as in their implementation. Given the flexibility and capacity of current electronic data processing techniques (if they are required) and the skills available to design

A basic marketing information system should be designed to provide most or all of the customer/product/sales force information needed. Focusing on the* decisions *each manager must make as part of his normal job responsibility helps to determine what his information requirements are and how his outputs of plans and forecasts can best be integrated into the information system.

EXHIBIT I



manual systems, the output of the Task Force should be in agreement with user needs.

The users are, of course, marketing managers with a wide variety of responsibilities and outputs, as is illustrated in Exhibit 1, above. These managers are charged with preparing plans covering sales volume, advertising and promotion programs, customer service, and sales force operations. Each of these plans and associated budgets becomes integrated into a marketing plan (product emphasis) and a sales plan (customer or territory emphasis). Other functional areas, shown on the right of the exhibit, rely on the marketing department's outputs as the basis for their own schedules, projections, and objectives.

The varying tasks of marketing executives might suggest separate data files and reporting systems for each kind of planning and monitoring activity. Such a system would be inefficient, however, and a more economical approach would utilize basic data sources for a variety of purposes.

The interfaces between marketing and other functional areas can present problems if users on either side are forced to work with data formats and definitions that are cumbersome or unfamiliar, simply to avoid a data processing step. For example, marketing managers may be comfortable with "cases" while production scheduling personnel prefer to work in terms of "pounds." A common unit is not necessarily required for both marketing and production as long as the two different units can be defined in terms of one another and procedures installed to maintain compatibility.

As discussed previously, it is not necessary that each marketing manager have a separate information system. The problems (and opportunities) in marketing information systems design arise from the need to utilize available sources for a wide variety of information requirements. Basic data sources usually consist of the following:

- invoices or other documents recording shipments of specific quantities to specific customers;
- accounting ledgers recording the disposition of funds for specific purposes;
- salesmen's call reports showing the frequency and nature of their activity;
- reports of inventory status, product costs, and project status;
- planning documents showing expected levels of activity for product volume, price levels, sales force activity, marketing expenditures, and projects, including statistical forecasts based on historical data; and
- external data, collected and analyzed for the purpose of establishing priorities among products, customers, and areas.

The list of basic sources has sev-

eral implications for marketing systems design work. First, most of the documents and records are designed for users in other functional areas such as accounting, production, and distribution. If they are to be utilized as part of a marketing information system, it will be necessary to modify the ways in which other users handle and distribute the basic sources. Second, plans are included as a source of information; they are also important outputs of the marketing management effort. Both aspects of the planning process are critical since information flows *within* as well as *between* functions. Finally, models and simulations are not included in the list; they represent "second generation" information systems projects for most companies. Managers can make better use of these sophisticated tools after they have fully explored the benefits of new procedures and reports.

The following example illustrates how basic data can be rearranged to provide marketing management with valuable information.

Case 1. A manufacturer of cosmetics utilized department stores, chain drug stores, and variety and specialty outlets for his channels of distribution. Each of his many products required substantial support in the form of special promotions, cooperative advertising arrangements with retailers, and partially or completely subsidized in-store sales personnel. As part of a larger effort to exercise more control of these expenditures, procedures were installed to identify expenses directly attributable to the different classes of retail outlets, in addition to product-by-product budget control. These procedures required subsidiary ledgers to accumulate marketing and selling expenses by class of trade. Exhibit 2, above, shows one of the resulting trade-class profitability reports.

Customer class profitability data had not been available before, and the new reports enabled management to pinpoint profit improvement opportunities. Exhibit 2 illustrates another key point about marketing information systems: They provide the tools for decision making, but not the decisions themselves. Based on the new cost and profit data, management could conclude that department store business was just not worth having, or it could conclude that the prestige and exposure afforded by department stores was worth the costs and low profit levels involved. Other alternatives involving changes in promotional programs could also be considered. The key to the decision remains the factual information provided by one element of the marketing information system.

EXHIBIT 2

TRADE CHANNEL PERFORMANCE

COSMETIC COMPANY

	% OF NET SALES	
	DRUG STORES	DEPARTMENT STORES
COST OF GOODS, FREIGHT, COMMISSION, INSURANCE	56%	53%
CO-OP ADVERTISING	3	10
SALESGIRL SALARY SUPPORT	0	21
COMMISSIONS IN OUTLETS	12	11
	71%	95%
CONTRIBUTION TO PROFIT & OVERHEAD	29%	5%

In contrast to other functional areas, marketing operations depend heavily on data originating *outside* the organization. External data from government publications, trade associations, business periodicals, and syndicated services provide marketing managers with indicators of market and product potential. In turn, these measures of potential establish the basis for assigning salesmen to particular geographic areas, industries, or customers; for allocating advertising and promotional dollars to specific buying groups or areas; and for forecasting volume performance.

Case 2. A small manufacturer of copper wire relied on his customers' buying expectations, as reported by his salesmen, to establish volume forecasts. Actual performance, however, was usually far short of forecast. By utilizing trade and government publications that reported on activity of his customers' customers, he was able to adjust his projections downward to compensate for the tendency of end-users of copper wire to place multiple orders as protection against stock-outs. It was found that these multiple orders were inflating the purchasing expectations of the manufacturer's direct customers.

The Task Force must identify the most appropriate sources for external data and pinpoint why, how, and by whom such information will be used. The availability of external data can have major effects on the organization and reporting of internal data. For example, geographic definitions used internally (such as districts and regions) may require realignment in order to provide direct comparability with external statistics dealing with countries or accepted industry trade area designations. Product groups also may have to be reorganized in order to match the categories found in trade literature or government publications. The tasks of rearranging and reclassifying internal data usually require extensive recoding and wholesale changes in key master files.

Planning is one of the most im-

EXHIBIT 3

SALES PLAN

SALESMAN Morgan TERRITORY 27 YEAR 1971 SEASON Fall

ACCOUNT CLASS	CALLS TO BE MADE						TOTAL	CUMULATIVE VOLUME OBJECTIVES $ (000)						TOTAL
	JUL.	AUG.	SEPT.	OCT.	NOV.	DEC.		JUL.	AUG.	SEPT.	OCT.	NOV.	DEC.	
KEY/MAJOR	2	1	1	2	1	1	8	12	16	25	29	32	40	40
OTHER ACTIVE	1	1	1	1	1	1	6	1	3	4	6	8	9	9
PROSPECTIVE	1	2	–	–	–	–	3							
TERR. TOTALS														

The Task Force responsible for marketing systems design needs to define the responsibilities, formats, and timing necessary to produce plans for product sales, sales force manpower levels and call frequency, promotion and advertising expenditures, and summary budgets and profit contribution plans for the entire marketing and sales function.

portant elements of sound management—it provides the basis for evaluating performance and exercising control. Unfortunately, planning procedures that should be part of the most basic marketing information systems tend to get pushed aside in the rush to design and install new reporting systems. Planning systems are usually an afterthought even though the simplest report serves little purpose without some predetermined benchmark against which results can be measured.

Case 3. The sales manager in a textile company supervised the activities of some 80 salesmen and district managers. He found that continued hiring of salesmen did not seem to improve overall performance, even though his field managers insisted that more men were required to cover the market. A more formal and effective way to plan sales force activity was adopted, as shown in Exhibit 3, above. The new sales planning procedures called for:

- identifying key customers;
- defining minimum call frequencies by customer class;
- assigning salesmen to territories of approximately equal potential; and
- developing sales objectives for key customers and territories based on potential and past performance.

The sales plan in this example covers a six-month selling season and specifies call frequencies for each major and prospective account,

EXHIBIT 4

CALL REPORTS → ORDERS

PERFORMANCE REPORT

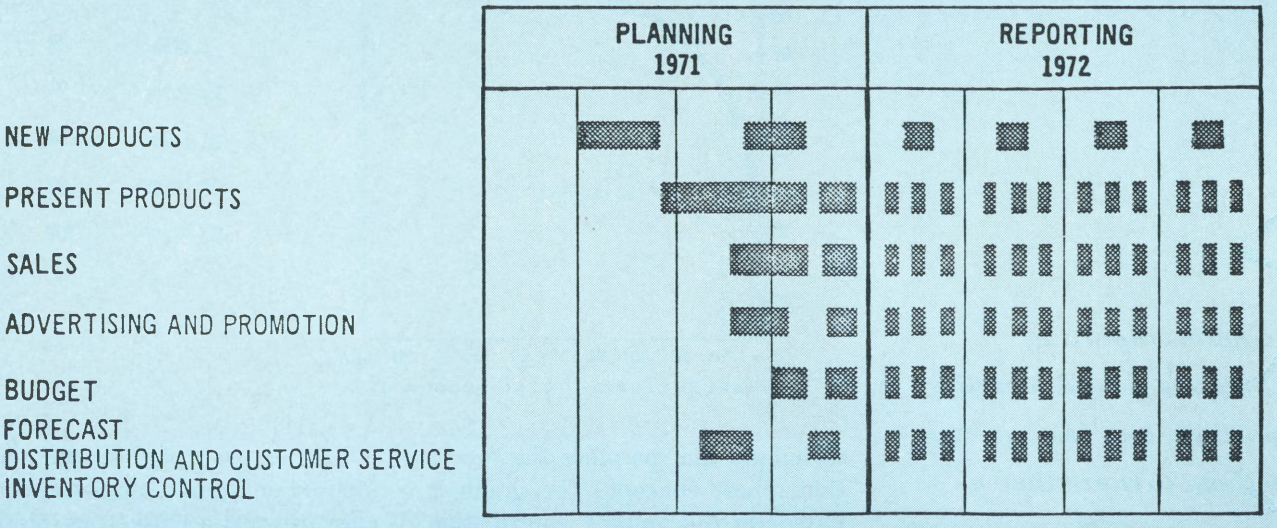
SALESMAN Jones TERRITORY 14 PERIOD THROUGH March 31, 1971

	SALES VOLUME			PROFIT INDEX		CALLS	
	PLAN	ACTUAL	LAST YR.	PLAN	ACTUAL	PLAN	ACTUAL
KEY/MAJOR	7,200	8,100	6,500	100	104	4	4
ALL OTHER							
NEW							
• TOTAL	90,000	100,000	75,000	100	102	210	196
• COMMISSION	XXX			XXX		XXX	XXX

• ACCOUNTS	PLAN	ACTUAL
RETAINED	40	43
NEW	8	10

EXHIBIT 5

PLANNING TIME FRAME



as well as cumulative volume objectives. The summation of such territory plans becomes the basis for assigning salesmen and for checking total volume objectives against corporate goals. The sales manager must adjust the total of the individual account objectives downward to reflect probable account losses from season to season.

Controls over sales force activity were facilitated by regular reports like the one shown in Exhibit 4, page 24. The primary measures of performance—volume, call activity, price maintenance, and new account acquisition—are all monitored versus objectives using data from two basic sources, call reports and orders. A profit index is used to give the salesman an indicator of profit contribution without requiring the sales manager to distribute detailed profit margin data throughout his organization.

The Task Force responsible for marketing systems design needs to define the responsibilities, formats, and timing necessary to produce plans for product sales, sales force manpower levels and call frequency, promotion and advertising expenditures, and summary budgets and profit contribution plans for the entire marketing and sales function. Exhibit 5, above, illustrates the timing of plan preparation and the relationship between planning and reporting. In this example planning begins early in the year with the review and updating of long-range and new product plans. Other basic plans and forecasts are developed throughout the year, some sequentially and others concurrently. A "pause" in the fourth quarter provides for updating statistical forecasts with the most recent data available, prior to the final coordination and approval sessions necessary to establish objectives for the coming year. On the reporting side, progress is monitored against each plan on a monthly or quarterly basis.

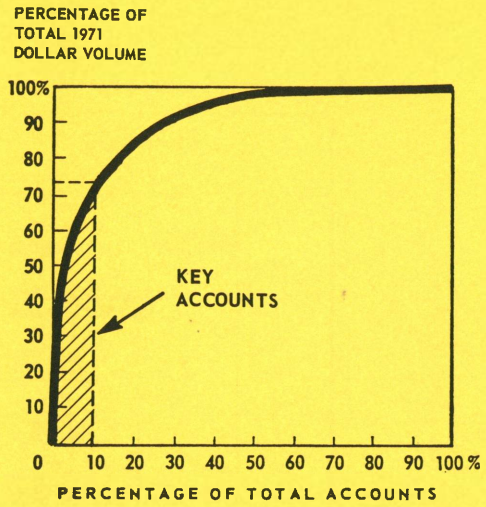
Once a Task Force begins to ask marketing managers what their reporting needs are, requests are likely to come thick and fast. Some managers have useful personal systems that they would like incorporated into any new system. Others will see the project as an opportunity to satisfy their curiosity, but they have no specific uses in mind for the information they request. These requests must be evaluated in light of the overall marketing approach either in use or contemplated by management. Even with experienced assistance on board to help sort out priorities, the eventual list of needs can be very long. The volume of reports can be staggering when levels of detail and reporting frequencies are considered.

Part of this problem comes about from confusion between data and information. Detailed reports of every individual sales transaction and marketing expenditure provide raw data only and are often unusable due to their bulk. Summaries, groupings, and limited report distribution procedures are required to make reports readable and manageable. Exception reporting techniques would also simplify reporting, but few systems utilize exception reports to more than a minor extent. Managers are reluctant to work with less than complete information at the levels of detail most convenient for them.

Exhibit 6, page 26, illustrates a

EXHIBIT 6

DISTRIBUTION OF VOLUME BY ACCOUNT



CUMULATIVE %	
Accounts	Volume
2 (45)	48
10 (210)	74
20 (430)	86
50 (1100)	97
100 (2200)	100

Exception reporting techniques would simplify reporting, but few systems use them to more than a minor extent. More common is a technique that parallels the exception report concept —fairly detailed reports on the small percentage of accounts that contribute the largest volume of business, with considerably less attention given to reports on the very small accounts.

technique that parallels the exception report concept. The graph is based on the volume contribution of each account, arranged largest first. Thus in this example, the top 10 per cent of accounts contribute 74 per cent of total volume. The importance of these accounts warrants frequent, detailed reporting on their activity, although the reports themselves will be relatively "thin"; key accounts are usually less than 20 per cent of the total number of accounts. The small accounts contribute relatively little volume and thus detailed reports of their activity do not add much to a manager's understanding of current market conditions. Some systems are designed to summarize the smallest accounts (perhaps several thousand of them) into a single line for reporting purposes.

The "key account" approach works equally well with product line reporting, especially for those companies that manufacture a large number of product variations that are distinguished by minor differences in size, color, packaging material, or shipping quantity. As the costs of electronic data storage decrease and the time pressures on marketing managers increase, information systems tend to emphasize more storage and less reporting.

Various parts of this article have focused on the reasons for directing effort toward a marketing information system; the basic user needs, data sources, and design techniques for such a system; and some of the potential problems involved. The focus has been on developing a basic system that will reflect the marketing approach and key information needs of marketing management.

The success of any concentrated effort to improve planning and control in the marketing function will depend most heavily, however, on the active support of senior management. "Active support" means defining the scope of the project, assigning qualified personnel on a full-time basis, participating in regular progress report sessions, and recognizing that a broad and detailed examination of needs and alternatives must precede implementation.

Most companies, large and small, have yet to scratch the surface in this critical area. Although designing and installing even a "down-to-earth" marketing information system can involve some hard work, a quick look at the resources allocated to the marketing function should be sufficient incentive to get started.

In today's environment, traditional controls must often be replaced by electronic controls. The authors discuss the four types of EDP internal control, with particular attention to —

THE APPLICATION AND RELIABILITY OF THE SELF-CHECKING DIGIT TECHNIQUE

by John O. Mason, Jr.
University of Alabama
and William E. Connelly
Touche Ross & Co.

IN THE development of computer-based information systems, system designers attach considerable weight to internal control features. The emphasis on internal control is related to the effectiveness of information systems. According to Felix Kaufman, "Control is a preeminent condition to data processing effectiveness. A properly controlled system will operate effectively with less than optimal design and equipment. The converse is not true."[1] The point is that computer-based information systems that do not include an adequate plan for control do not function effectively.

In order to add to the system designer's working knowledge of the overall control mechanism of an information system, the authors discuss the usefulness of the self-checking digit technique, an automatic control feature commonly found in information systems. This article describes and illustrates the application of the self-checking digit technique at various control points within an information system, explores advantages and cost of its adoption, presents the results of a simulation experiment conducted by the authors to test the reliability of selected self-checking digit methods, and interprets the findings in terms of which methods are superior in detecting different types of coding errors.

Because of the introduction of computers in business data processing, many traditional control measures are no longer available. However, new methods of control, often referred to as EDP controls, have been devised to substitute for human controls. There are four types of EDP internal control techniques, which may be classified according to control points within the information system:

1. *Source data controls* — which

[1] Kaufman, Felix, *Problems of Control in Electronic Data Processing,* Lybrand, Ross Bros. & Montgomery, New York, 1963, p. 9.

provide control over the creation and handling of source data outside the computer area. These include, among others, predetermined batch control totals, self-checking digit tests, review of source documents for completeness, key-verification, and visual verification.

2. *Hardware controls* — those built into computer hardware by the manufacturer. Some of the control techniques of this type include parity checks, echo checks, dual-gap heads, dual arithmetic circuitry, and sequential arithmetic circuitry.

3. *Program (software) controls*— tests of (a) input fed into the computer configuration to obtain assurance that all transactions transmitted from the recording point have been received at the processing point, and (b) items processed by the computer to determine whether the functioning of computer processing operations is as planned. Some of the control techniques in this area include limit checks, structural checks, alphanumeric checks, internal header and trailer labels, completeness checks, valid field tests, self-checking digit tests, record counts, batch control totals, sequence checking, cross-footing balance checks, and zero-balancing.

4. *Operations controls* — procedural controls over data processing operations within the computer area. Some of the control techniques of this type include the grandfather - father - son technique, remote storage copy of one file generation together with subsequent transactions, file protection ring, documentation, manual reconciliation of batch control totals and record counts, and external file labels.

Controls vary with systems

Not every control feature listed in the above four areas would be used in a given information system. In designing such a system, the system designer should consider the entire set of controls in relation to the nature of the business and the environment in which they are applied, rather than view individual controls in isolation. However, whenever a business uses numeric codes to identify customers, inventory, products, or employees in order to facilitate the processing of transactions against master files and the effect of an incorrect coding is critical, then the self-checking digit technique should be applied.

Dramatic growth in the number of computer installations during the last two decades has given rise to the increasing use of codes in recording and classifying data. Codes are essential in computerized data processing systems for identifying accounts, customers, products, employees, and cost centers because the shorter the identifier of a piece of data, the less costly the processing. With the use of codes, data accepted for analysis can be easily assigned to appropriate accounts, files, reports, and analyses according to desired management information groupings. It is obviously less costly to record and process the number 8 1 4 9 7 3 to identify a customer in a sales transaction, for example, than to use the full customer name. Less key punch operator time is required, less space is needed on transaction records, and less computer operating time is used.

Whereas codes facilitate the classification of data in computer-based information systems, errors in codes give rise to the misclassification of data. Assume that the following transaction is recorded: John Q. Smith purchases ten widgets on account, total price $15.90 (including tax). Under a manual accounting system, the customer would be identified by name on the sales invoice and in the sales journal. Under computerized accounting, Mr. Smith would be identified on a transaction medium (punched card, punched paper tape, magnetic tape) by a code number, say 8 1 4 9 7 3. Furthermore, in the updating of the accounts receivable master file, the number 8 1 4 9 7 3 would be used in matching the transaction against Mr. Smith's master record in the accounts receivable file.

Assume further that in the manual system the source document is improperly completed—that, instead of John Q. Smith, the name John Q. Smyth is recorded. Since the name John Q. Smyth probably is not listed as a customer in the accounts receivable subsidiary ledger, the transaction would not be accepted for updating accounts receivable until the clerk has corrected the error. Assume, however, that in the computer-based system the customer's number is inadvertently miscoded—that, instead of John Q. Smith with account number 8 1 4 9 7 3, Henry J. Green's account number 8 4 1 9 7 3 (transposition error) is introduced at some point in the data stream. Since account number 8 4 1 9 7 3 is also listed in the accounts receivable master file, the transaction would be processed against the wrong master record in the receivables file because the code, though valid, is incorrect.

To eliminate coding errors caused by human failures and machine malfunctions, the system designer must consider incorporating the self-checking digit technique within the overall internal control mechanism of the information system. The self-checking digit tech-

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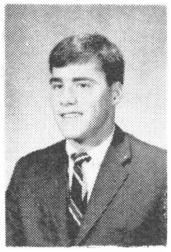
JOHN O. MASON, Jr., CPA, is an assistant professor of accounting at the University of Alabama. Previously he was an instructor at the University of Missouri and a staff accountant with a major accounting firm. Dr. Mason received his B.S. and M.S. degrees from Louisiana State University and his Ph.D. from the University of Missouri. He is a member of the American Accounting Association's committee on responsibility for financial statements.



WILLIAM E. CONNELLY, CPA, is a staff accountant with Touche Ross & Co. in Nashville, Tenn. He received his B.S. from David Lipscomb College, in Nashville, and his M.A. from the University of Alabama. Mr. Connelly is a member of the National Association of Accountants and Beta Alpha Psi, the professional accounting fraternity.

nique tests the validity of a numeric code, such as a customer account number in the example above. This is done by applying a mathematical formula to the number itself. The principle behind the technique is that if the formula produces a result equal to the extreme right-hand digit[2] of the number, the number is accepted as valid. If the formula does not produce a result equal to the right-hand digit, the assumption is that an error has occurred in either recording or processing the number. That is, the identification number is not the same at this point in the data stream as it was when it was initially issued to identify a particular data item.

Transposition errors

As a framework in which to illustrate the application of the self-checking digit technique at various control points in a computer-based information system, let us look at the transaction discussed earlier (the sale of widgets to customer John Q. Smith) in which the customer number 8 1 4 9 7 3 was transposed to 8 4 1 9 7 3. Chances are (as will be shown in the next section of this article) the transposition error will cause the transaction to fail the self-checking digit test. Consequently, either the transaction entry will not be transmitted to the computer for processing or, if accepted by the computer, an error message will be printed and the transaction skipped. Only those transactions that pass the self-checking digit test will be processed against the master file.

The self-checking digit technique is not a single technique, but a family of techniques. The four basic methods described below are commonly found in information systems:

[2] Although the check digit must appear on the right of the number if the checking is performed on a card punch, it is also quite common to find check digits preceding numbers in systems which use optical readers. Good examples of this are the various credit card accounts used by oil companies, department stores, etc.

1. The Modulus 10 'Simple Sum' method is the easiest to understand because it requires only a few relatively simple calculations. With this method, a self-checking number is formed in the following manner:
   a. Begin with a basic code number
      8 1 4 9 7 3
   b. Sum the digits in the number
      $8 + 1 + 4 + 9 + 7 + 3 = 32$
   c. Subtract the sum from the next highest multiple of 10
      $40 - 32 = 8$
   d. Check digit
      8
   e. Self-checking number
      8 1 4 9 7 3 8

2. The Modulus 10 '2-1-2' method is more complex in that each digit of the basic code number, beginning with the units digit, is weighted by the consecutive factors of 2, 1, 2, 1, 2, . . . In this method, a self-checking number is formed as follows:
   a. Begin with a basic code number
      8 1 4 9 7 3
   b. Apply consecutive weights of 2, 1, 2, 1, 2, . . . to each digit of the basic code number, beginning with the units digit and progressing toward the highest-order digit
      8 1 4 9 7 3
      $\times$ 1 2 1 2 1 2
      $\overline{8}\ \overline{2}\ \overline{4}\ \overline{18}\ \overline{7}\ \overline{6}$
   c. Sum the weighted digits
      $8 + 2 + 4 + 18 + 7 + 6 = 45$
   d. Subtract the sum from the next highest multiple of 10
      $50 - 45 = 5$
   e. Check digit
      5
   f. Self-checking number
      8 1 4 9 7 3 5

3. The Modulus 11 'Arithmetic' method, like the previous method, is based on a weighted scheme, but each digit in the basic code number is weighted by a separate factor.
   a. Begin with a basic code number
      8 1 4 9 7 3
   b. Apply consecutive weights of 2, 3, 4, 5, 6, 7, 2, 3, 4, 5, . . . to each digit of the basic code number beginning with the units digit and progressing toward the high-order digit
      8 1 4 9 7 3
      $\times$ 7 6 5 4 3 2
      $\overline{56}\ \overline{6}\ \overline{20}\ \overline{36}\ \overline{21}\ \overline{6}$
   c. Sum the weighted digits
      $56 + 6 + 20 + 36 + 21 + 6 = 145$
   d. Divide the sum by 11
      $145 \div 11 = 13$ with 2 remaining
   e. Subtract the remainder, 2, from 11
      $11 - 2 = 9$
   f. Check digit (When the arithmetic process generates a result of eleven, the digit 0 is substituted.)
      9
   g. Self-checking number
      8 1 4 9 7 3 9

4. The Modulus 11 'Geometric' method is almost identical to the Modulus 11 'Arithmetic' method, except that the weighting factors are based on a geometric sequence of 2.

With the Modulus 11 'Geometric' method, a self-checking number would be obtained in the following manner:
   a. Begin with a basic code number
      8 1 4 9 7 3
   b. Apply consecutive weights of 2, 4, 6, 8, 16, 32, 64, . . ., 2^n to each digit of the basic code number, beginning with the extreme right-hand digit and progressing toward the high-order digit.
      8 1 4 9 7 3
      $\times$ 64 32 16 8 4 2
      $\overline{512}\ \overline{32}\ \overline{64}\ \overline{72}\ \overline{28}\ \overline{6}$
   c. Sum the weighted digits
      $512 + 32 + 64 + 72 + 28 + 6 = 714$
   d. Divide the sum by 11
      $714 \div 11 = 64$ with 10 remaining
   e. Subtract the remainder, 10, from 11
      $11 - 10 = 1$
   f. Check digit (When the arith-

metic process generates a result of eleven, the digit 0 is substituted.)
1

g. Self-checking number
8 1 4 9 7 3 1

These four methods of the self-checking digit technique are referred to, respectively, as:

1. Mod 10 Simple Sum
2. Mod 10 Alternate
3. Mod 11 Arithmetic
4. Mod 11 Geometric

The control points at which the self-checking digit methods may be applied to detect and correct errors are: (1) creation and handling of source data outside the computer area and (2) computer processing. As a source data control, the technique provides a means of verifying the accuracy of coded data at the same time it is converted to machine-usable form. The requirements for using the technique at the data conversion station are as follows:

1. The self-checking number feature must be installed on the input preparation device, whether it be a card punch, paper tape punch, or magnetic tape recorder.[3]

2. A check digit must be generated for each basic code number to be self-checked.

For example, the self-checking feature may be installed on an IBM Model 29A Card Punch. The operator, who controls the feature by a toggle switch and special punches in the program card, keys the code number as it appears in the source document. Internal calculations by special circuitry attached to the card punch verify both the accuracy of the keying operation and the validity of the self-checking number as it appears on the source document. When the number on the source document is correct and the number is keyed correctly, the keying operation continues uninterrupted. On the other hand, if the number is not keyed correctly or if the self-checking number appears incorrectly on the source document, the card punch (once the number is keyed by the operator) will signal an error and lock up.[4]

How error is caught

Let us expand the framework established in the preceding section (the sale of widgets to customer John Q. Smith) by adding the assumption that management adopted the designer's recommendation that the Mod 11 Arithmetic check digit method be applied as a source data control. Moreover, assume that John Q. Smith's previous customer number, 8 1 4 9 7 3, was converted to the following self-checking number 8 1 4 9 7 3 9. (The check digit 9 was appended to basic account number 8 1 4 9 7 3 in order to form the self-checking number 8 1 4 9 7 3 9.) Assume further that the number was correctly entered on the sales invoice, but was incorrectly punched by the key punch operator as 8 4 1 9 7 3 9 (transposition error). At the time the number was incorrectly keyed by the operator, the self-checking digit circuitry of the card punch would perform the following internal calculations:

1. Begin with the transposed code number
   8 4 1 9 7 3 9
2. Apply consecutive weights of 2, 3, 4, 5, 6, 7 to each digit of the basic code number
   $$\begin{array}{rrrrrrr} 8 & 4 & 1 & 9 & 7 & 3 & \\ \times & 7 & 6 & 5 & 4 & 3 & 2 \\ \hline \overline{56} & \overline{24} & \overline{5} & \overline{36} & \overline{21} & \overline{6} & \end{array}$$
3. Sum the weighted digits
   $56 + 24 + 5 + 36 + 21 + 6 = 148$
4. Divide the sum by 11
   $148 \div 11 = 33$ with 5 remaining
5. Subtract the remainder, 5, from 11
   $11 - 5 = 6$
6. Result
   6
7. Compare result with check digit of code number
   $6 \neq 9$

Since the result calculated by the self-checking digit circuitry does not equal the check digit (step 7 above), a red light will appear on the keyboard and the keyboard will lock. The operator must release the punched card by pressing an error reset key and then repeat the keying process. If the number is correctly punched the second time, the keyboard will not lock and the operator will be able to complete preparation of the transaction card.

Assume, however, that the number was entered incorrectly on the sales invoice. An error will be indicated each time a card is punched from the sales invoice. The second time an error is indicated, the operator will assume that the number on the sales invoice is invalid, a situation which must be remedied before the transaction can be converted to machine-usable form and transmitted to the computer for processing.

The self-checking digit technique also may be incorporated as a part

[3] Installation of the self-checking number feature on the input preparation device was the first use of the check digit technique, but in today's third generation computer world this is not always necessary. Some system designers would prefer that the key-verification technique be used to catch key punch errors and that a complete edit run by the computer, prior to the time transactions are processed against the master file, be used to detect source document coding errors.

[4] *Reference Manual—IBM 29 Card Punch*, IBM, Poughkeepsie, New York, 7th ed., 1970, pp. 28-32.

FIGURE 1

ACCOUNTS RECEIVABLE UPDATING RUN
SEQUENTIAL (BATCH) PROCESSING

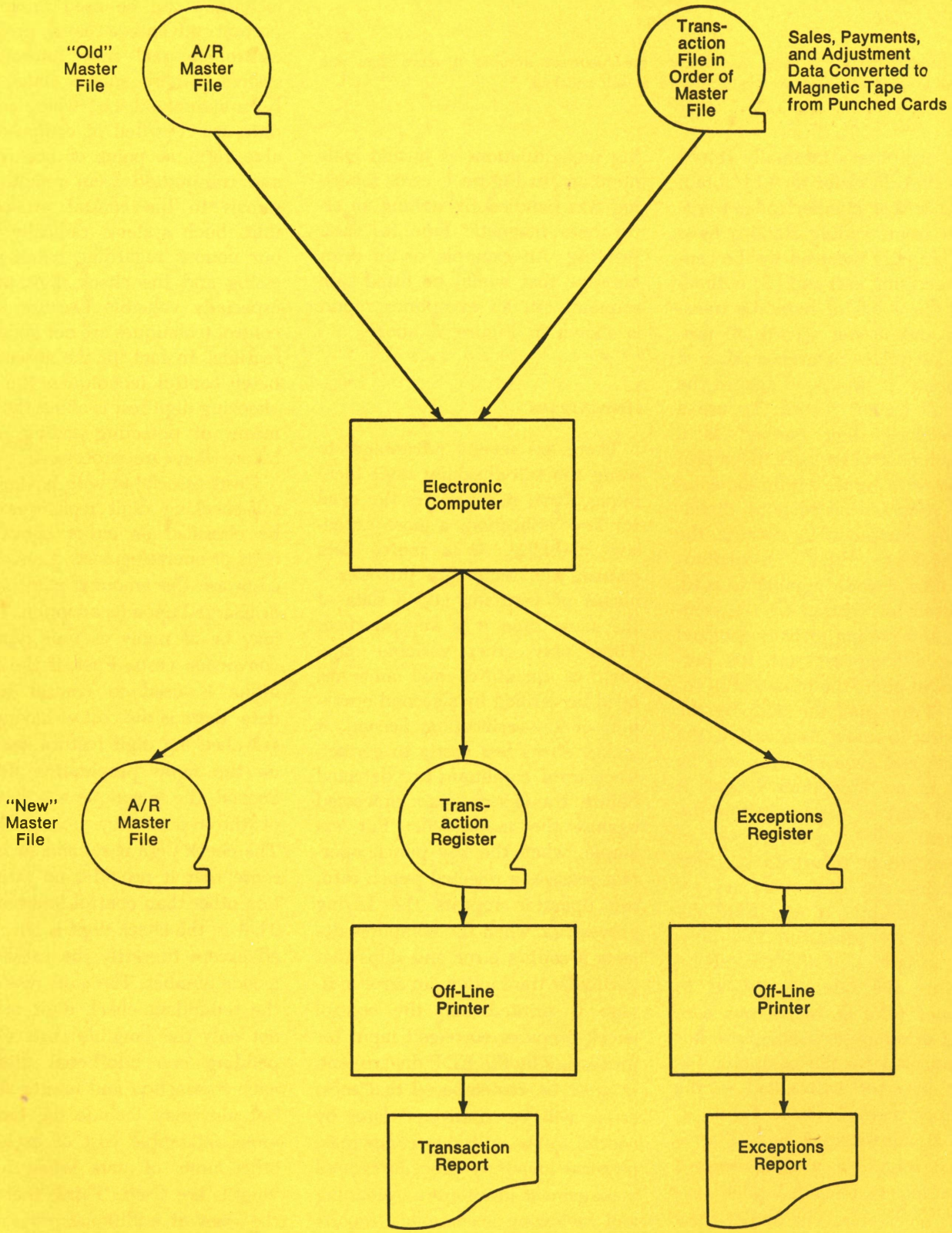


FIGURE 2

EXCEPTIONS REPORT
ACCOUNTS RECEIVABLE UPDATING RUN
FRIDAY, FEBRUARY 19, 1971

CUSTOMER NUMBER	SALES INVOICE	AMOUNT
8419730*	983756	$15.90
etc.	etc.	etc.

* An asterisk would be used to indicate the incorrect number if more than one number in a transaction or master record is self-checked.

of the computer's internally stored instructions in order to: (1) obtain assurance that number codes transmitted from reading stations have been properly received by the central processing unit and (2) authenticate the codes of both the transaction and master records to provide adequate assurance that a transaction is processed against the intended master record. To use a self-checking digit method as a program control requires that a programer incorporate within the computer program instructions directing the computer to execute the self-checking digit calculations each time a code number is read, processed, or written by the computer. If a coding error is detected during a computer run, the program will abort the transaction. Instead of the operator stopping the computer to make a correction, the location and type of error will be listed in an exceptions report. A control clerk or the originating department will be given a copy of the exceptions report to see that the items are corrected and returned promptly to the EDP department for processing. To illustrate, assume that the transaction involving the sale of widgets to customer John Q. Smith was converted to computer-usable form but was rejected by the computer because an error was noted in the customer number code. Figure 1, page 31, illustrates a typical error routine found in a computerized accounting system to update accounts receivable. The output from the updating run ordinarily would include an exceptions report noting such situations as invalid code numbers. In Figure 1, error reporting was handled by writing an error onto magnetic tape for later printing. An example of an error message that would be listed subsequently in an exceptions report is shown in Figure 2, above.

Advantages

There are several advantages to using the self-checking digit technique. First, it eliminates the need for key-verification, a more expensive checking. As a source data control, the technique provides a means of verifying coded data at the same time it is key punched. Thus, only other variable data, such as quantities and amounts, need be verified by a second operation of key-verification. Second, it makes errors less costly to correct, since error conditions are detected before transactions are processed against the master file. For example, when the key punch operator releases a rejected punch card, the operator repeats the keying process; or when the computer detects a coding error and skips that particular transaction, an error message is printed and the control check prepares corrected input for processing by the EDP department. It must be remembered that most errors will be discovered later by control totals, customer complaints, physical inventory procedures, and management intuition in examining and reviewing accountants' reports and analyses. However, the cost of correcting errors can be high if the computer has processed them as if they were correct. The self-checking digit technique obviates the cost of correcting certain file errors, for such errors are detected and corrected before a transaction is processed against the master file.

Third, the self-checking digit technique can be used to an important advantage as a program control in real time information systems where source data have been automated, i.e., where source data are recorded in computer-usable form at point of occurrence and transmitted from remote terminals to the central processing unit. Such systems radically alter our notions regarding batch processing and the check digit test is especially valuable because batch control techniques are not generally feasible. In fact, in the absence of batch control techniques, the self-checking digit test is about the only means of detecting coding errors before they are processed.

Costs associated with having this self-checking digit technique may be classified as either conversion costs or operating costs. Conversion costs are the amounts paid, given, or charged upon its adoption. There may be as many as four types of conversion costs. First, if the technique is used to control source data, there is the cost of having the self-checking digit feature installed on the input preparation device. Second, the technique is a member of the redundancy check family. The check digit is redundant in the sense that it provides no information other than control information. That is, the check digit is not needed except to verify the validity of a code number. The costs related to the redundant check digit include not only the tangible costs of appending one additional digit to each transaction and master record but also may include the less obvious intangible cost of excluding other units of data when record lengths are fixed. Third, there are the costs of additional programing time. Programers must write programs that convert code numbers

to self-checking digit numbers. Moreover, if the technique is implemented as a program control, programers will have to modify existing programs in order to incorporate within them the self-checking digit algorithm (systematic set of equations representing the self-checking digit calculations). Fourth, existing plates or cards encoded with customer, product, employee, or process identification numbers will have to be scrapped and new ones issued.

Operating costs involve the costs of computer time used in performing the self-checking digit algorithm.[5] While the cost of computer time for a single transaction or even one day's transactions may not be material, this will not be true of the costs of additional computer time requirements for an entire year. For example, assume that in the accounts receivable updating run illustrated in Figure 1, the computer is processing 1,000 transactions against a master file of 25,500 records. Even if the self-checking digit algorithm was performed only once a day, six days a week, for each transaction and master record, the calculations would be executed by the computer 8,268,000 different times a year. Even for a computer whose operating cycle is measured in terms of a few hundred nanoseconds (billionths of a second) the total time required for carrying out the self-checking digit calculations would be substantial.

Reliability of methods

How reliable are the self-checking digit methods? The answer to this question was the final objective of the study. This aspect of the study took the form of a simulation experiment, in which the four self-checking digit methods described previously were used in an attempt to detect simulated errors in a hypothetical set of ten thousand seven-digit, self-checking code numbers. In all, attempts were made to detect five different types of errors. They are described below:

Assume the correct number is
8 1 4 9 7 3 9

1. Single transcription error — where one digit is copied or processed incorrectly
   8 3 4 9 7 3 9
2. Single transposition error — where the position of two digits in a number is interchanged
   8 4 1 9 7 3 9
3. Double transposition error — where the position of two sets of digits in a number is interchanged
   8 4 1 7 9 3 9
4. Random scramble – where the entire number is garbled
   7 6 2 3 5 9 6
5. Substitution of a valid, but incorrect number
   6 5 2 0 1 0 3

Before presenting the results of the simulation, a few comments about the methodology are in order. First, for each check digit method, ten thousand self-checking numbers were generated. Second, an error of each type illustrated above was simulated in each of the self-checking numbers; and an attempt was made to detect such errors by means of the self-checking digit algorithm. Third, the percentage of errors detected was computed by type of error. Fourth, this procedure was repeated for each of the four check digit methods; the results appear in Table 1, page 34. The percentage of detected errors may be taken as an index of reliability—the greater the percentage of errors detected, the higher the degree of reliability present.

Clearly, all methods are not equally reliable. The ability to detect errors is greatest in the Mod 11 methods. In all error categories the Mod 11 methods detected coding errors as well as or better than

There are several advantages to using the self-checking digit technique. First, it eliminates the need for key-verification, a more expensive checking. As a source data control, the technique provides a means of verifying coded data at the same time it is key punched.

[5] In batch processing operations, additional computer time will not be required to perform the self-checking number calculation if this edit technique is carried out when punched cards are loaded to magnetic tapes and edit processing operations are overlapped with input/output operations.

TABLE I

RELIABILITY FACTORS ASSOCIATED WITH SELF-CHECKING DIGIT METHODS (ROUNDED TO THE NEAREST PER CENT)

SELF-CHECKING DIGIT METHOD / TYPE OF ERROR	SINGLE TRANSCRIPTION	SINGLE TRANSPOSITION	DOUBLE TRANSPOSITION	RANDOM SCRAMBLE	SUBSTITUTION OF VALID, BUT INCORRECT NUMBER
Mod 10 — Simple Sum	100%	0%	0%	90%	0%
Mod 10 — Alternate	94%	90%	90%	90%	0%
Mod 11 — Arithmetic	100%	90%	90%	90%	0%
Mod 11 — Geometric	100%	90%	90%	90%	0%

the Mod 10 methods. There is an extremely small probability that these results were due to chance (less than one in a thousand).

With the exception of single transcription errors, the Mod 10 Alternate method was third best. The Mod 10 Simple Sum method performed least well (except in the single transcription error category). The most crucial factor affecting reliability seemed to be the weighting of digits (versus non-weighting), while the weighting scheme was a somewhat less important factor.

None of the methods is 100 per cent reliable. In fact, all are quite powerless to combat a special type of error—that of assignment of an incorrect, but valid code number for another. The explanation of reliability is an interesting topic, but is not explored here because of an already lengthy article. However, part of the answer can be traced to the fact that self-checking digit methods are capable of generating check digits which have but ten possible values, 0 through 9. Because more than one code number will be assigned the same check digit, there is always the possibility that a substitution or transposition of digits in one number may result in another valid number (the latter number having the same check digit as the former number).

Summary

Nearly two decades have passed since the first commercially available computer was introduced in the United States. Since that time, as Geoffrey Horwitz recently pointed out, the number of computers installed within the United States has doubled every three years and this rate of increase is expected to continue.[6] As the number of installations continues to increase, the system designer's emphasis on problems of achieving proper control of computer-based information systems will probably persist.

In this article, the writers have illustrated the application of an automatic control feature at various control points within an information system. Designated the self-checking digit technique, it tests the accuracy of coded data during: (1) conversion to machine-usable form and (2) computer processing. Because the technique makes it possible for an information system to detect incorrectly coded transactions before they are assigned to accounts, files, reports, and analyses, errors are less costly to correct. Another cost advantage associated with the application of this control feature is that it partially eliminates the need for the more costly key-verifying operation.

The writers also investigated the reliability of four check digit methods found in information systems. The results of a simulation experiment indicated that, contrary to claims of upwards of 100 per cent effectiveness, none of the methods is nearly that reliable. Moreover, they vary substantially in ability to detect coding errors; in all error categories considered, the Mod 11 methods detected coding errors as well as or better than the Mod 10 methods.

Thus, the self-checking digit technique provides information systems with an automatic control device for detecting coding errors. Though not 100 per cent effective, when complemented by predetermined batch total techniques, the check digit test greatly strengthens internal control over EDP operations.

[6] Horwitz, Geoffrey B., "EDP Auditing —The Coming of Age," *Journal of Accountancy*, American Institute of CPAs, New York, August, 1970, p. 48.

Cost reduction is the order of the day in many businesses today—but unplanned and reckless cost-cutting can drive expenses higher than ever. Here's a plea for intelligent and well-thought-out-

COST-CUTTING THAT WORKS

by E. Leonard Arnoff
Ernst & Ernst

THE PROBLEMS facing today's decision maker are more complex and of broader scope than ever before. Furthermore, the economy has experienced some rather severe shocks during the past year and a half. Executives are faced with ever increasing costs and slumping profits. They are searching for more effective ways to cope with mounting financial problems. As one remedy, many executives, many companies, have instituted cost reduction programs.

How does one evaluate the effectiveness of cost reduction programs? Have the intended savings actually been achieved, or are the projected savings lost in the shuffle of frantic change?

If, in fact, a cost reduction program is really beneficial and results in savings, how can we quantify, or measure, such savings—especially since the benefits can be not only economic but also psychological and sociological?

In this article, we shall examine these questions, and discuss how one can evaluate the effectiveness of cost reduction programs.

This past winter, we were all offered, via television, a smorgasbord of professional football games. For each contest, each team developed a predetermined "game plan"—a plan for scoring more than its opponent. But, alas, all too often, finding themselves seriously behind and trying desperately to catch up, many teams abandoned their plans and went to the long pass. Many such passes, anticipated by the defense, became desperation throws and proved ineffective (i.e., incomplete) or costly (e.g., interceptions).

So it is with cost reduction programs. When such programs are launched *without* a sound plan, or when prior plans are set aside, cost reduction programs usually become ineffective, often costly, desperation moves.

Cost-cutting procedures must be

part of a well-conceived, well-executed plan. Further, such planning must consider not only likely or desired conditions—but must also include plans for emergency conditions, such as those which create the very need for cost-cutting.

To illustrate—for many years, the frozen orange concentrate industry planned only for processing a *full* crop since, it was reasoned, the industry could not predict the specific timing and severity of crop-damaging freezing weather. It waited until a freeze occurred; then it obtained revised estimates of crop yield and developed new plans for that season—but usually only after a substantial lapse of time.

To achieve a sound plan—including contingency measures—we need to be able to answer a wide variety of 'what if?' questions; that is, questions that ask what would happen if certain contingencies were to arise. Such questions are best answered—and corresponding plans best developed—by means of simulation models and other mathematical representations of the system.

A plan for all seasons

Now, however, at least one major processor plans for the full spectrum of possible crop yields—and develops corresponding plans for each level of yield. Then, if and when a freeze occurs, it is fairly easy to get a revised estimate of the yield and quickly shift into the correct, previously designed, revised plan. Appropriate reductions in labor force, in materials, in transportation facilities, and the like are then all smoothly carried out according to the predetermined plan.

And, so, a sound, well-conceived, well-executed plan is not only highly desirable for cost reductions—it is virtually essential if such cost reductions are to be effective.

Such a plan requires that the objectives and goals of the organization be spelled out in an operationally meaningful sense; that corresponding measures of effectiveness are specified; that appropriate standards, targets, or budgets exist; and that evaluation procedures are established *in advance*.

To achieve a sound plan—including contingency measures—we need to be able to answer a wide variety of "what if?" questions; that is, questions that ask *what* would happen *if* certain contingencies were to arise. Such questions are best answered—and corresponding plans best developed—by means of simulation models and other mathematical representations of the system.

Thus, through mathematical models, cost reduction measures—such as cutting back on inventories—can be carried out according to sound plan rather than on an indiscriminate, or arbitrary, basis. Otherwise, inventories will undoubtedly be out of balance, customer service will be far worse than anticipated, expediting of rush orders will increase significantly, production costs will increase substantially, and, in brief, hoped-for cost reductions will end up as substantial cost increases.

Stated another way, through mathematical models, we can determine how best to achieve the desired end results.

Thus, for example, for one manufacturer, the usual inventory study failed to achieve much. However, with the help of a consultant, he then found that, by offering discounts based on the amount of delivery time given by the customer (instead of the usual quantity discounts), the resulting orders permitted substantial manufacturing economies and also allowed inventories to be reduced by 55 per cent without any reduction in customer service.

More generally, through mathematical models which consider many factors and interactions throughout the system, we can determine unprofitable or low-margin products, customers, territories, offices, warehouses, production lines, distribution methods, and so forth. Thus, once again, conditions requiring cost reductions can be anticipated and, if and when these conditions are encountered, the ap-

E. LEONARD ARNOFF is National Director of Operations Research at Ernst & Ernst, and is a principal in its Management Consulting Services Division in Cleveland. His textbook **Introduction to Operations Research** has been published in eight languages. Dr. Arnoff is a past international president of the Institute of Management Sciences and a fellow of the Operations Research Society of America and the American Association for the Advancement of Science. He was recently made an honorary member of Beta Alpha Psi, the national accounting fraternity.

propriate cost reductions can be carried out in a sound and effective manner.

As an illustration, consider a company which sought to reduce clearly excessive inventories. For this company, only 15 per cent of the products were directly profitable and accounted for 86 per cent of total sales. On the other hand, 35 per cent of the products accounted for only 0.8 per cent of total sales. An apparent inventory control, or inventory reduction, problem was really a problem of appropriately reducing the product line. In fact, the initial reduction of the product line by only 10 per cent resulted in benefits approximately four times greater than would have been expected from a near-perfect inventory control system. Also, substantial reductions in inventory resulted automatically.

The example just cited also shows that, in evaluating the effectiveness of cost reduction programs, one must consider lost opportunities. Thus, a direct attack on inventories would have meant the loss of the far greater benefits achieved through reducing the product line.

Of course, while espousing the use of mathematical models, it should be emphasized that unless such models result in plans, decision rules, and procedures (1) which are implemented, (2) which really work, and (3) which are cost-effective, our efforts are *not* successful.

Furthermore, the plans and mathematical models used to develop cost reduction programs can also be used to evaluate the effectiveness of these programs. In fact, such an evaluation is an essential part of the analysis—in which the various alternatives are evaluated and the best ones are selected for implementation.

In evaluating the effectiveness of cost reduction programs, one must also consider the long-run implications of emergency measures, for example, those taken during a business downturn. Otherwise, short-run gains may very well cost much more in the long run.

For example, as noted earlier, short-term inventory reductions can very easily result in out-of-balance stocks, greatly reduced customer service, increased expediting, much higher production costs, and, eventually, lost customer sales.

To cite another illustration, a company instituted emergency cost reductions so indiscriminately as to result in severe negative employee reaction, production slowdowns, and bitter negotiations with respect to the next union contract. Temporary savings were wiped out and significant added costs were incurred.

Or, consider what can be called the "airline syndrome." Substantial losses have been accompanied by reductions in service (a type of cost reduction) and by round after round of rate increases . . . thus leading to less-than-anticipated passenger mileage and still further losses . . . and so on.

In all cost reduction programs, one must also consider— and evaluate—the effect of such programs on the rest of the organization. Otherwise, gains will be localized, often at the disproportionate expense of other parts of the organization. Some illustrations—for example, inventory reduction—have already been cited. Let us cite one other example here.

A metal producer noted that its interplant shipments cost $12 million per year. Quoting the old saw —"If we can reduce these costs by just 10 per cent, we will save $1,200,000 per year,"—they proceeded to apply the mathematical technique of linear programing to minimize interplant transportation costs. To their chagrin, the indicated savings were only $67,000 per year. A consultant was then called in—and he pointed out that they were attempting to solve much too narrow a problem. In fact, the solution yielding the $67,000 per year savings in transportation costs would have resulted in added production costs of $4,000,000 per year. It might also be noted that by minimizing *total* relevant costs —including those of materials and

In evaluating the effectiveness of cost reduction programs, one must also consider the long-run implications of emergency measures, for example, those taken during a business downturn. Otherwise, short-run gains may very well cost more in the long run.

production as well as transportation —an $8 million annual saving was then achieved.

Incidentally, one common fallacy is assuming that cost reductions will continue ad infinitum. This, of course, is unwarranted, even if one compromises by calculating the present value of such assumed lifelong savings.

Up to now, we have been discussing cost reduction programs. Actually, in most cases, we really should be looking at profit improvement. This is certainly true for most computer applications and also for most so-called management information systems. Too many have been directed toward the almost universal myth of cost reduction, instead of to profit improvement!

Too many cost reduction programs have been devoted to doing something more efficiently rather than more effectively. Too many programs have been devoted to discovering how to do it cheaper—rather than to asking, "Why do it?" and "What *should* we do?" Thus, a cost reduction approach can, in effect, result in our asking, "How do we make a cheaper buggy whip?" rather than asking, for example, "How can we better serve the transportation market?"

Returning to our inventory examples—perhaps, instead of reducing inventories, we should be looking at ways to effectively balance, and perhaps even increase, inventories, so as to provide improvements in manufacturing costs, better customer service, improved deliveries, less expediting, less crash procurement of materials, and so forth . . . thus resulting in more business and better profits. Which approach we take depends, of course, on corporate objectives—but the proper approach can be determined and taken in a sound manner.

More specifically, consider a Midwestern machine tool manufacturer operating a job shop that produced almost entirely to customer order. He switched from producing parts in job lot quantities to producing economic order quantities of parts based on a forecast of customer demand for each type of machine. As a result, inventories increased, as did the amount of scrap or obsolete inventory.

Is this bad?

No; and that's the point. Overall, direct manufacturing costs were reduced in excess of 20 per cent. In addition, delivery lead times were greatly reduced, customer satisfaction was increased, and many more orders were received—resulting in substantially increased profits!

Summary

In summary, cost reduction programs and, often more appropriately, profit improvement programs can best be designed through the development of sound, overall plans ——where these plans include provisions and procedures for anticipating and responding to emergency conditions. Without such plans, cost reduction programs will generally be ineffective and often damaging.

Such plans can be developed through the use of mathematical models and simulation models designed to answer a wide variety of "what if?"-type questions.

Such plans and models incorporate and respond to operationally meaningful definitions of corporate objectives and goals; corresponding measures of effectiveness; and appropriate standards, targets, and budgets. Thus, evaluation procedures can be (and must be) established in advance. Consequently, the very same plans and models used to *develop* cost reduction programs can also be used to *evaluate* the effectiveness of these programs.

As also noted, in evaluating the effectiveness of cost reduction programs, one should:

1. Consider the long-run implications of emergency measures,
2. Consider the effect of any cost reduction on the rest of the organization,
3. Consider lost opportunities, and, finally, one must always
4. Compare the benefits of cost reduction with those to be achieved through profit improvement.

As noted at the beginning, the problems (and opportunities) facing today's decision maker are more complex and broader in scope than ever before. Managers are faced with endeavoring to achieve simultaneously a wide variety of objectives, many of which are in conflict. Resources are limited and must be used effectively. Uncertainties are ever-present—with respect to the market, economic conditions, competition, costs, etc. There is always a risk involved. (Note that we all talk about taking "calculated risks," but few of us ever really calculate them. The risks must be calculated—and *can* be calculated through quantitative methods.)

Hence, today's decision maker is engaged in what might be called a gigantic "corporate crapshoot." However, while the rules are usually well-known (e.g., in dice—when to pay and when to collect after a roll of "7"), very few executives really understand the odds, and the tactics and the strategies that should be used.

So it is with cost reduction programs. Many executives know the "rules," but all too few understand the odds and have insight into the best tactics and strategies. Application of mathematical models (and quantitative methods) is one important key to providing this understanding . . . and to providing sound, effective cost reduction and profit improvement programs.

The sophisticated executive will use planning and mathematical models to supplement and augment that which has made him a manager—his knowledge; his skills; his perceptiveness; and his feel for opportunities, situations, people, and timing.

As a result, far more decisions—far more cost reductions and profit improvements—will be made in an atmosphere of informed judgment, rather than on a crash basis in an atmosphere of crisis.

Both absorption costing and direct costing schools have their advocates. But, as this article shows, what is appropriate for one firm or industry may be wholly inappropriate for another—

MANAGEMENT'S PRICING DECISION

by John C. Lere
Illinois State University

AN accountant called upon to provide information to assist the management of a firm in its pricing decision will probably react by computing some type of cost figure. Numerous "cost" figures have been proposed at different times as solutions to the "cost for pricing purposes" problem. Faced with many potential candidates for a cost to give management for use in pricing and convincing arguments in favor of each, the accountant may throw up his hands in dismay, use a coin to make the decision for him, or perhaps use his "favorite" cost figure, whatever that favorite cost figure may be.

One approach to solving the accountant's dilemma is for him to further analyze the decision management must make. The decision to be made may be one of two basic types: 1) What price should we charge for our product? 2) Should we accept a price offered for our product?

The actual decision a firm faces makes a difference in the most suitable "cost" to use in the pricing decision. The remainder of this article expands the idea of different costs for different pricing decisions. Although only two costing methods, absorption and direct, are used in the article, the analysis could be extended to other costing methods.

Initially, ways of using each costing method in pricing are presented. Then, four different types of firms are described in order to determine the actual decision being made and a suggested "cost" to assist the decision maker.

Two exhibits help to explain how absorption costing and direct costing might be used in product pricing.

One must start with a basic set of data from which to work. Two

similar firms will be used in the exhibits. AB Company uses absorption costing. DIR Company chooses to use direct costing. To facilitate comparison, the same basic data will be used in both of the examples.

Basic data

Past experience of AB Co. and DIR Co. has shown that each unit that they produce requires two and one-half units of raw material and three hours of direct labor. In addition, they have determined that the average purchasing price for raw material is $2.00 per unit and that the average wage rate they pay is $2.50 an hour. The companies must also decide upon a measure of business activity with which to asssociate cost for purposes of allocating variable overhead. Any indicator of the level of activity at which AB Co. and DIR Co. are operating could have been selected, e.g., machine hours operated or units produced. Both companies have chosen to use direct labor hours. Studies by their engineering departments have indicated that those elements of overhead which can be classified as variable are incurred at the rate of $1.00 per direct labor hour.

Several additional facts are necessary to permit use of absorption costing. Some measure of activity must be chosen for use in allocating fixed overhead to units of production. Since it has already been indicated that variable overhead incurrence is related to the number of direct labor hours worked, direct labor hours will also be assumed to be a suitable basis for fixed overhead allocation in order to simplify the example. Again, any indicator of the level of activity at which AB Co. is operating could have been chosen. Once an activity base is selected, it is next necessary to estimate the expected amount of activity for a given period of time. Also, the fixed overhead which the company expects to incur during the same period of time must be predicted. One year will be used in this example. The base chosen depends on the operations of the particular firm. During the period of one year, AB Co. expects to work 200,000 direct labor hours and expects to incur $300,000 of fixed overhead. When absorption costing is used in the pricing decision, some method of converting production cost into price is customarily provided. A markup rate of 50 per cent of total manufacturing cost will be used, but numerous other possibilities exist. With this information available, it is now possible to begin computation of an absorption costing price.

Exhibit I, below, left, shows the computation of an absorption cost price for the AB Co.'s product.

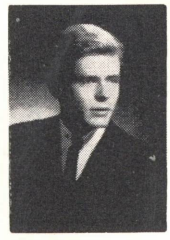
Briefly, computing a price for the AB Co. product under absorption costing involves seven steps. First, raw material usage for one unit of finished product is multiplied by the average cost of a unit of raw material. Second, labor usage in producing one finished unit is multiplied by the average wage rate. In the third step, the same labor usage figure is used and multiplied by the variable overhead rate in order to determine the amount of variable overhead to assign to a finished unit. The fourth step in Exhibit I involves the same labor usage figure. This time, however, the figure is multiplied times the fixed overhead rate (computed by dividing the fixed overhead expected for the period of time by the expected number of labor hours to be worked during the same length of time). Direct material cost per unit, direct labor cost per unit, unit variable overhead cost, and unit fixed overhead cost are totaled in the fifth step to determine unit manufacturing cost. For the AB Co. product, the sixth step involves multiplication of a markup rate times the unit production cost. The final step is the addition of manufacturing cost and the markup to determine price.

In using direct costing to assist DIR Co.'s management in its pric-

EXHIBIT I

AB Co. Product Price: Absorption Costing

Unit Cost of Manufacturing		
Direct Material	(2½ units x $2.00/unit)	$5.00
Direct Labor	(3 hours x $2.50/hour)	7.50
Variable Overhead	(3 hours x $1.00/hour)	3.00
Fixed Overhead	(3 hours x [$300,000/200,000 hours])	4.50
Total Unit Manufacturing Cost		$20.00
Markup ($20.00 x 50%)		10.00
Unit Selling Price		$30.00



JOHN C. LERE, CPA, is an assistant professor of accounting at Illinois State University at Normal. Previously he headed the business department of Winston Churchill College in Pontiac, Illinois. Mr. Lere received his bachelor's degree from the University of Illinois and his master's from the University of Texas at Austin. He was the recipient of the Ernst & Ernst Academic Achievement Award at the University of Texas.

ing decision, one might take a different approach. Since the basis of direct costing is that fixed costs are not unit costs, the only cost elements to be used are ones which vary in total amount with the level of activity. Therefore, one might compute variable unit cost in much the same manner as was used above for the unit cost of manufacturing under absorption costing, except that fixed overhead is omitted. In addition to the variable manufacturing costs, one should also include variable selling and administrative expenses in the variable unit cost figure. For purposes of the example, the variable selling and administrative expenses are assumed to amount to $2.50 a unit. (See Exhibit II, below.)

The total variable unit cost, $18.00 in this case, is the significant figure for use in DIR Company's pricing decision. DIR Co. can use this figure to evaluate a price offered to it or a price determined by some other means. For example, the marketing division may suggest this as a successful price for a new product. In this example, price determined independently is assumed to be $29.00. If the bid price is greater than total variable unit cost, each unit the firm sells will reduce a net loss or increase net income by the contribution margin, which is the difference between price and total variable unit cost. (This assumes that the firm need not increase facilities to produce the product being evaluated.) If no other alternatives are available for use of the firm's facilities, the firm would be advised to sell the product in the short run. During the short run, the firm will be unable to reduce productive capacity and hence a major element of fixed overhead, depreciation. Therefore, accepting any price greater than total variable unit cost under the circumstances will maximize short-run income or minimize short-run loss.

The two pricing exhibits point out the basic difference in approaching the pricing decision. Absorption costing results in the setting of a price and direct costing results in determining whether a firm should accept a price. In other words, absorption costing is more appropriate when a firm's pricing decision takes the form: What price should we charge for our product? On the other hand, direct costing appears more useful when a firm's pricing question is: Should we accept a price offered for or suggested for our product?

Determining the pricing decision

Consideration of several industry examples may illustrate some of the different pricing decisions faced by firms. Four firm types will be discussed. The types are a) a seller of a uniform product on an open market, b) a novelty item firm, c) a price leader, d) a price follower.

Looking first at the firm selling a uniform product on an open market, one may observe that this firm has an economic environment that closely approximates what the economists call "perfect competition." By definition, a firm in perfect competition has no control over price. Price is determined in a market where the aggregate buyers and sellers interact to yield a price. Then the seller must decide if he will accept the price or not. Accepting the price will enable the firm to sell as many units of its product as it wishes at the market price. Not accepting the price means that the firm sells none of its product and probably will not produce any units of the product. If the firm has no reasonable alternative ways to use its capacity, then it faces a net loss equal to its fixed costs, because it cannot reduce them in the short run. This firm is faced with the decision of accepting a price or rejecting a price. Therefore, the firm will probably find direct costing a more useful aid in the pricing decision than absorption costing.

Place for direct costing

Although one may be unable to find firms in a situation exactly like that described above, one may still find the analysis useful. To the extent that a firm must accept a price determined in the market place, direct costing better answers the question than does absorption costing.

The second type of firm definitely doesn't face the market-place-determined price because usually no

EXHIBIT II

DIR Co. Product Price: Direct Costing

Unit Variable Manufacturing Costs:		
Direct Material	(2½ units x $2.00/unit)	$5.00
Direct Labor	(3 hours x $2.50/hour)	7.50
Variable Overhead	(3 hours x $1.00/hour)	3.00
Total Variable Manufacturing Costs per Unit		$15.50
Variable Selling & Administrative Costs per Unit		2.50
Total Variable Unit Costs		$18.00
Contribution Margin ($29.00-$18.00)		11.00
Price, obtained independently		$29.00

market exists for its product. The novelty firm develops a product like the "hula hoop" or "super ball" or "frisbee." It must then, in effect, establish a market place for its novelty item. One might reason that the novelty firm management is definitely faced with a decision of what price to charge for its product. Management of this novelty firm has, however, found that a price recommended by marketing researchers is more realistic for its economic environment than a price developed by accountants. The management of the firm is faced with the need to evaluate the price presented by the marketing experts. The evaluation determines whether or not the novelty item is produced.

The evaluation presumably is based on the acceptability of the price recommended. In other words, should we accept the suggested price or not? This decision is clearly one of the type for which information provided using direct costing will be more useful.

A few introductory comments might help to make discussion of the last two types of firms clearer. Many industries today seem to be guided by a firm called a "price leader." The price leader's function is to set a price which other firms in the industry will voluntarily follow.[1] An increase in the price leader's price serves as a signal to the other producers that costs have increased to such a level that prices must be increased to protect the level of profits.[2] Since the leader's position is one existing only because of the voluntary acceptance of his price by others in the industry, one is faced with two different types of decision. One decision must be made by the price leader, the other by the price follower.

Looking first at the price leader, one can see that he must set a price. That firms do have the ability to set a price and make it stick is well documented.[3] The question is, then, what type of pricing decision must be made. Since the price leader is concerned with a price to protect profits, he is required to decide what price to set, not whether to accept a price. He would be served better by absorption costing in making the decision as it yields a price.

This solves the problem of the price leader. A decision is also faced by the "price follower."

Presumably he need not set a price. He need only review a price change made by the leader in his industry and decide whether to follow or not. His decision, should he "accept" a price "offered" for his product, is of a form better solved using direct costing.

In these last two cases, one can see that not only are firms in different types of industries faced with different decisions, but even firms in the same industry may be required to answer different questions.

The price leader must set a price. He would be served better by absorption costing in making the decision as it yields a price. The 'price follower's' decision, whether to 'accept' a price 'offered' for his product, is of a form better solved using direct costing.

The decision

Although some accountants may find explicit answers to pricing problems they face in this article, they are misguided if they attempt to fit all pricing decisions into the four "cubbyholes" reviewed above. Each firm has a slightly different economic environment and different factors influencing the price. Just as there is no example of the economist's "perfect competition," there also are no one or two pricing decisions all firms face. As accountants we should be aware of this. When management asks for financial information to aid in the pricing decision, we should stifle the urge to bring out our favorite absorption costing figures, or direct costing figures, or marginal costing figures, until we have answered for ourselves the question: What is management's pricing decision?

[1] Chamberlin, Neil W., *The Firm: Micro Economic Planning and Action*, McGraw-Hill Book Co., Inc., New York, 1962, p. 366.

[2] *Ibid.*, p. 365.

[3] Galbraith, John Kenneth, *The New Industrial State*, Houghton-Mifflin Company, Boston, 1967, pp. 48-49.

Part One—

Both optimistic and pessimistic notes about future sounded by luncheon speakers at the Boston—

SEVENTH ANNUAL COMPUTER CONFERENCE

A Management Adviser Staff Report

THE INFORMATION flow within a company is no longer "about the operation of the company—it is part of the operation," Marshall Armstrong, president of the AICPA, told the Tuesday luncheon session of the Seventh Annual Conference on Computers and Information Systems, sponsored by the Institute in Boston May 24-26.

Although computers have been around for a quarter of a century and full management information systems have existed for the last ten or fifteen years, 1971 is a particularly significant year for accountants both in their role of helping the client, their "planning services," and in their role of helping the client use his computer, their "systems work," Mr. Armstrong said.

"Let's look at planning services first," the speaker continued. "The planning process of defining the problem, sizing up the situation, gathering and analyzing the facts and assumptions, and selecting a sound course of action permeates all situations in which we are attempting to cope with an uncertain future. But then, what other kind of future is there?

"Without usurping management prerogatives and responsibilities CPAs have been useful in helping clients with their planning problems. The computer has opened wide new horizons in this area. In past decades, when we engaged in planning, the human labor in coping with the interaction of just a few variables was monumental. Who among you CPAs cannot recall the stacks of many-column worksheets that went into a planning study? Change one variable and there went another two mandays with the desk calculator and the pencil and the eraser."

The computer has changed all that, he said—an adviser can now provide as many combinations of as many factors as anyone cares to read and ponder. But this in itself has created a new problem.

Managers today do not suffer from a lack of relevant information, he pointed out. "Rather they suffer from an overabundance of irrelevant information. The computer is

obviously capable of calculating and printing vast quantities of words and numbers. . . . What is too often overlooked is the capability of the computer to scan, screen, filter, select, and condense information to meet the needs of a particular manager with a particular problem."

Such an analysis of a problem, however, requires human judgment, knowledge, and effort, he said. "I see this as your greatest challenge when you are wearing your planning consultant's hat—to make the best use of the computer in focusing relevant information where and when it is needed.

"In a planning model, the ability to plan 'what if?' is of the essence," he continued. "For example, what if the economy turns down or up? What if consumer tastes shift from product A to product B? What if the rate of growth of something changes? I think you should direct your planning energies to this type of thinking—to the real world of buying and selling, of competition in the marketplace, of new products and facilities replacing the old. The computer model can cope with these complexities if you can specify them."

However, to perform fully in this new role, accountants will have to "look beyond the credits and debits of the accounting system," Mr. Armstrong warned. "You must concern yourself with the pounds and dozens—and the hours—that go into buying and selling products," he said. "You must develop a feel for rates of change and their implications, for the present values of future cash flows, for changes in products and processes and the time and costs of bringing these changes about. When you can think of a planning model as being a realistic selection of the important bits of the real world that impinge on your client's problem, you're on the way to being an effective planning consultant. The computer can do the arithmetic and the logical operations if you can select the relationships and parameters of the model."

The profession has still not fully developed two technical areas in planning, he warned. One of these is simulation, providing for the entry into planning elements of random elements in the real world and basing resulting plans on the observed probabilities of events occurring.

Risk analysis in planning new facilities is a good example of this, he said, as is production planning.

"The other underdeveloped area," he continued, "is sensitivity analysis, which may be thought of as an extension of the 'what if?' concept. It is the measurement and consideration of the impact of one variable on another. For example, at next year's level of operations, what will be the effect on net income of various rises in the cost of raw material A? This type of analysis enables the CPA to quantify the 'what if?'s.' "

Turning to the other CPA planning role, that of systems consultant, Mr. Armstrong said that it no longer encompasses preparing a chart of general ledger accounts or even computerizing the present information flow, as it once did.

"Now, in 1971, it seems to me that CPAs are coming to recognize that the flow of information and the flow of management action must coincide," he said. "The client's system really consists of his entire organization—its structure, its people, its policies, practices, myths, and physical resources, its outside world of customers, suppliers, competitors, governing bodies, and the general public as well as the flow of information that pulses through the organization.

"When someone changes management structure and responsibilities, such as by appointing a task force, someone needs to change the flow of information to parallel the change in structure. Conversely, when we modify the information flow we need to have some feel for the impact that this change has on the overall system. This is so because the information flow and the system itself are interdependent. As information flows become closer to real time, the distinction between what is 'information' and what is 'operations' starts to become meaningless. If you question this, you need think only of an airline ticket window, an on line bank teller window, or a factory process control system. The information is no longer about the operation of the company—it is part of the operation."

The challenge to CPAs, then, in systems analysis, evaluation, and installation lies in forgetting the old, arbitrary distinctions between accounting information and other types of management information; they are all part of the same stream, coming from the same source documents, going through the same programs, and emerging in the same output formulas, he said.

The accountant's challenge is to consider the segments of management reached by a given piece of information, the decisions that have to be made at that level, and the degree of detail that is required or that may be required, he said.

"The computer is carrying you into the mainstream of your client's operations," Mr. Armstrong declared. "You will need to know more about his operations than ever before to do your own job of helping to develop a dynamic, flexible, responsive flow of relevant information."

If the AICPA president, luncheon speaker for the second day of the meeting, was optimistic about the future, the Monday luncheon speaker, Bernard Goldstein, president of ADAPSO (Association of Data Processing Service Organizations),

was critical of some past developments in the computer service industry.

Tracing the development of data centers, Mr. Goldstein conceded the computer had been badly oversold.

"Actually, it's neither a panacea nor an electronic wheel—though it's been presented in both contexts," he said. "Nobody but the hobbyist wants the computer, but all mankind wants the results it can produce. The service concept is a viable alternative."

He said there are four distinct types of data service organizations:

1. The traditional data center;
2. The software supplier;
3. The facilities management organizations; and
4. Time sharing facilities.

As a result of the much publicized success of the industry, folk heroes have developed, like Sam Wiley of University Computing or, more recently, H. Ross Perot of Electronic Data Systems. Each new and prematurely "public" service was represented as the "new Xerox."

Then, with the onset of the recession in 1970, and the end of the flow of new capital, many of the poorly managed operations collapsed, no longer "able to bury errors with fresh cash."

"Where good management existed, the companies survived," Mr. Goldstein declared. "Most of those that had restricted their activities to what they knew how to do well, to specialties, survived."

Still the loss rate has been so high that the New York City classified telephone directory today has four pages less listings for EDP service companies than it did at the end of 1969.

But the net result is that the companies that are still in business are, for the most part, "here to stay," the association official continued.

"The unqualified have had their day at bat and are now out of the ball game," he went on. "We have moved from the entrepreneurial stage to the managerial stage in EDP."

Some problems remain, he said. For example:

"The banks have been moving into data processing services in violation of both law and the spirit of the law," Goldstein said.

"The continued concentration of economic power is an implicit danger to our society. In Japan, if you look very carefully at almost all of the large industrial cartels, you will find banking and banking institutions at the center. That may be all very well for Japan but is it for us?

"ADAPSO has fought the banks' intrusion in Washington and the courts. But where was the AICPA? Where was the AICPA at the:

"Patman Committee hearings?

"Sparkman Committee hearings?

"Federal Reserve Board hearings

"Your strong voice was silent. As a result, a new innovative industry may become part of the banking system—without any strong logic of relationship.

"The time has come for this great Institute and great profession to speak out on these broad issues affecting our society and economic system. A 'new wind' is blowing and you should be part of it."

Payoff coming

The conference, which was held at the Marriott Motor Hotel in suburban Newton rather than in central Boston, opened with a keynote address by Patrick McGovern, president, International Data Corporation and publisher of *Computerworld*, on the topic "1970—The Payoff Decade for EDP."

Mr. McGovern, reviewing a research study recently completed by his firm, said that the average budget for a computer installation today is $600,000 and that this figure is expected to increase by 12-14 per cent during the next three years. Outside services currently take 53 per cent of the total budget, he said, and this percentage is expected to rise as users increasingly employ outside software, time sharing, and data processing services.

Discussing the implications of the "transition to consumerism" that has occurred in the computer industry during the past two years, he said that consumers now have the sophistication—and the motivation—to direct and control the rate of growth of new computer applications. This growing sophistication has been fostered by the recent rash of "unbundling," the emergence of new product lines, and the economic recession, he said.

"The industry has graduated from a manufacturer-developed field to a user-directed market," he said.

Citing areas where he believes CPAs have special responsibilities to EDP operations of their clients, McGovern said these were:

Security and protection of data and records handled by the data center,

Ensuring the adequacy of systems that yield historical and operating business information,

Verification of the adequacy of data entry procedures and identification of critical trouble points in developing accurate computer processing records,

Promoting standards by which the competence of data processing staff personnel can be evaluated, and

Monitoring emerging laws and regulations concerning privacy in data banks to ensure that the client's installation violates none of them.

The 1970s can become the "Payoff Decade for EDP" if the CPA in both his auditing and financial advisory function applies realistic measures to his clients' computer operations and actively participates in educating top management in the potential of EDP, he said.

Following the keynote address conference registrants broke into small groups to discuss a variety of EDP topics: income tax preparation, time sharing, the benefits and penalties of operating a service center, and management information systems.

The final event of the morning was billed as "A Famous Accountant Considers Automation." It developed that the presentation was a film and the famous accountant was that even more famous television star, Bob Newhart, who, before he found TV work more lucrative and more satisfying, actually was an accountant. The film portrayed Mr. Newhart in one of his well-known one-way telephone calls hearing from one Herman Hollerith concerning Hollerith's news of his latest brainchild, the punched card.

Newhart, of course, reacted to the news and the details very much as a quite unimaginative accountant probably would have responded to a telephone conversation outlining the principles of the punched card when it was first developed in the late 19th century. Readers who have seen Newhart's portrayal of a half-incredulous, half-amused English cabinet minister responding to Sir Walter Raleigh's telephone recital of the financial possibilities of tobacco in the early 17th century will have a fairly accurate picture of the "famous accountant's" general response to the whole idea of punched cards, the origin of today's computer.

In the first afternoon session, Arthur Martin, director of systems and data processing, Squibb-Beech-Nut, analyzed some of the "trade-offs" that must be made in choosing any form of EDP.

There are advantages and drawbacks in any system chosen, Mr. Martin pointed out. The wise company will consider each of these in terms of its own objectives before choosing any one mode.

Some of the factors to be considered, he suggested, are:

- The necessary flexibility of the system.
- The importance of system security.
- The importance of the timeliness of data handled by the system.
- Controls in the system.
- The cost/savings/profit ratios of the system.

Security, he said, is an increasingly important factor in the area of information processing. Security can be divided into several classifications. Three arbitrary classifications might be external security, internal security, and personal security. In general, it was the speaker's opinion that the question of security is much more critical and vulnerable in the area of information systems and computers than it is in manual operations. Security has to be an important consideration in an information system, he went on. Do you have proper back-up? What will happen when you experience a power failure? Who should have access to the files and how is such access controlled?

If these questions are answered, he said, you will probably provide better security than you may have experienced in the past. On timeliness, he pointed out that an on line system would seem to have all the advantages. But consider, he said, what would happen to a company that had an on line system if every sale were recorded the moment it occurred. If production were adjusted to respond to such instantaneous receipt of information it could be in a state of constant chaos for a manufacturing firm that produces for inventory.

Cost savings and profits are entirely possible through EDP, he said, but the reverse situation is equally possible. He recommended that every company, before becoming involved in EDP, make out a balance sheet of exactly what it hoped to gain and what it might have to lose in terms of employee turnover, loss of security, and unexpected development costs.

He then outlined some specific data processing techniques, with comments on when they were and were not appropriate. Time sharing, he said, was good for limited input, limited output operations when the processing itself was fairly complex. If those conditions did not exist, he implied, he would be cautious about time sharing.

To the idea of installing an "in-house computer," he said, a logical question would be "What's the next best alternative?" Does the company have the personnel for its own computer operation? Is it prepared for the emotional shock of changeover to a computer?

Service bureaus, he pointed out, posed the danger of the client's being "locked in" with only the selected outside bureau understanding the procedures through which the company's records are updated. This can be overcome by specifying that the records involved can be transferred to another site. Also, he said, it is a good idea to obtain some "in-house" talent.

Package program techniques, he said, are good even though they are still somewhat limited. Perfectly acceptable accounts receivable and accounts payable packages that can be applied by a wide variety of companies are now available, he declared, even though some purchasing companies may have to compromise their procedures on some points.

In response to a question from the floor as to the wisdom of modifying packaged programs internally, Martin said he would advise against it.

"I don't recommend modifying a packaged program internally," he said. "If it has to be done, request the supplier to do it as a first choice."

The next afternoon session was devoted to a discussion of the AICPA Information Retrieval Pro-

gram by William Bruschi, director of information retrieval for the AICPA.

The AICPA system, which will be a library or information retrieval system, has its origins in the problems CPAs have in retrieving information about current accounting practices and treatments, Mr. Bruschi said. The project was undertaken in response to the urging of Institute members that the Institute's information gathering and disseminating capabilities be expanded to better fill the needs of the profession.

The system will not replace the Institute library or eliminate the need for specialized Institute publications. Instead, as experience is gained in use of the system, the functions of the library and the contents of the publications will be examined to determine how they and the retrieval system can be combined to best serve the information needs of the profession.

In his investigations of operating systems, Bruschi soon found that the greatest advances in technology usually arose in the course of developing systems for governmental agencies. He also found that one of the first jobs in the field is to separate the experts from the charlatans.

"We also found that users of the system must play a major role in designing it," he said, "because designers are apt to become so enamored with their system that they forget its end use."

After his initial investigations, his approach, Bruschi said, was to bring into existence two consultation groups or Task Forces. The Information Task Force is made up of potential users and has the job of outlining the needs which the system must meet. The System Task Force is expected to find the system that would best meet those needs.

So far the Information Task Force has established the following guidelines:

1. The system should be designed primarily to meet the needs of accounting firms. While the system will be made available to other subscribers, its acceptability will be enhanced if its primary use is by accounting firms.

2. The system should be an on line-real time interactive system.

3. The system should be based on key word interrogation techniques, so that a set of words—say "receivables," "pledged," "dishonored"—would retrieve information designated by the words.

4. The initial data bank will be composed of accounting treatments and disclosures in corporate annual reports. Other data banks will be compiled from prospectuses and proxies. Subsequent banks will be formed from accounting literature, accounting firm subject files, and Institute promulgations.

Access to the system will be obtained by subscribing CPA firms through terminals in their offices and a network of leased lines. The Institute hopes that terminals will eventually be installed in state society offices to make the system truly national in scope, Bruschi said.

The installation proposed is based partly on one already in use by the Ohio Bar Association, Bruschi reported. That system enables law firms to search a data file of Ohio court cases dating back to 1823 through the use of key word interrogation techniques.

The last Monday session consisted of three concurrent groups, each considering one aspect of a "Management Information System in Action." The panel group this correspondent attended, moderated by Richard Guiltinan, of Arthur Andersen & Co., discussed the use of time sharing and terminals. In general, the panelists were enthusiastic about the use of time sharing terminals, pointing out that in some cases the use of them for tax work alone justified the entire cost of the terminal so that any additional work done with them was in effect free to the user.

The Monday meetings concluded with an open house reception at the Marriott. (*To be continued*)

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When a company faces the prospect of a major capital investment, its decision can hinge on whether accrual or cash flow techniques are used to evaluate return on that investment. The author suggests a combination of the two to gain—

A BETTER PERSPECTIVE ON CAPITAL EXPENDITURE DECISIONS

by William L. Ferrara
The Pennsylvania State University

WITHOUT doubt the most crucial decisions facing managements are capital expenditure decisions. In the usual case these decisions involve rather large commitments of funds with the hope of attaining an objective such as increased profitability, a greater share of the market, and even improved relations with employees, stockholders, or the public at large.

Some typical decisions relate to expansion via the addition of new products, plants, sales territories, and even the acquisition of entire companies. The significance of these decisions is immediately obvious, since once the decisions are made the company will be committed to a pattern of activity as well as a pattern of expenditure for an extended period of time.

Unfortunately, there are too many practitioners as well as academicians who do not really understand the alternative methods available to evaluate the financial aspects of these expenditures. Furthermore, there is insufficient understanding of the fact that some of the usually discarded methods might be especially appropriate from a behavioral point of view. Finally, there is too little understanding of the thought that some of these methods are more appropriately considered complementary rather than mutually exclusive alternatives.

Thus the purpose of this article is twofold: 1) to review the alternative methods with the thought of placing them in proper perspective from a theoretical and behavioral point of view and 2) to put forth the idea that some of the alternative methods complement each other and, accordingly, should not be thought of as alternatives but as useful parts of the total package of information presented to a decision maker.

All of the usual techniques for evaluating capital expenditure decisions can be evaluated via the following illustrative problem:

> Amex Company is considering the introduction of a new product. The new product will

TABLE 1

Accrual Accounting

Return on Investment	Residual Income
Calculate the percentage return on average investment[1] during the life of the project. Make the go–no go decision on the basis of whether or not the calculated percentage exceeds the desired minimum.	Include in the incremental income calculation a charge for the use of capital, i.e., for the average investment[1] required based upon the minimum desired return. Make the go–no go decision on the basis of whether or not the incremental income does or does not exceed the capital charge.

Cash Flow Accounting

Return on Investment[2]	Net Present Value
Calculate the percentage return on investment. Make the go–no go decision on the basis of whether or not the calculated percentage exceeds the desired minimum.	Reduce incremental cash flows to their present value by discounting at the desired minimum rate. Make the go–no go decision on the basis of whether or not the net present value is positive or negative.

[1] Some might prefer to use original investment.
[2] Also known as the "internal rate of return."

be manufactured in an existing plant; however, new equipment costing $150,000 with a useful life of five years (no salvage value) will be necessary. The space in the existing plant to be used for the new product is currently used for warehousing. When the new product takes over the warehousing space, Amex Company will rent warehouse space at an annual cost of $25,000. The new product will be sold via an already established marketing organization. An accounting study produces the following estimates of incremental revenue and expense on an average annual basis:

Sales	$500,000
Cost of merchandise sold (excluding depreciation)	
Variable	230,000
Fixed	150,000
Depreciation of new equipment (straight-line)	30,000
Warehouse rental	25,000
Marketing expense—3% of sales	15,000

The company requires an after tax return on new investment proposals of 10 per cent. The Federal income tax rate is 50 per cent.

Even though all would agree that only incremental items (i.e. those items which will change because of a specific decision) are to be considered in decision making, there is often disagreement on whether the incrementalism should be in accrual terms or cash flow terms. Under each approach there are two basic methods, which can be described as shown in Table 1, above.

Accrual accounting is based upon the philosophy that income is recognized when it is earned (a right to receive cash exists) and expenses are recognized when they are incurred (an asset is used up or a debt is owed). Under the cash flow technique income is recognized when cash is collected and expenses are recognized when cash is paid.

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EXHIBIT I

Accrual Accounting Calculations

a) Incremental Annual Income

Sales		$500,000
Cost of merchandise sold	$380,000	
Depreciation	30,000	
Warehouse rental	25,000	
Marketing expense	15,000	450,000
Net income before tax		$ 50,000
Tax @ 50%		25,000
Net income after tax		$ 25,000

b) Incremental Average Investment

Original investment plus investment (book value) at end of useful life divided by 2 or (150,000 + 0) ÷ 2 = $75,000

c) Return on Investment

Incremental annual income divided by incremental average investment or $\frac{25,000}{75,000} = 33\frac{1}{3}\%$

d) Residual Income

Incremental annual income less a charge for the use of capital or

Net income after tax	$25,000
Less: Capital charge 10% of 75,000	7,500
Residual Income	$17,500

EXHIBIT II

Cash Flow Accounting Calculations

a) Incremental Annual Cash Flow

Net income after tax	$25,000
Add: Non-cash deduction Depreciation	30,000
Annual cash flow	$55,000

b) Incremental Cash Investment

$150,000 investment (outlay) for new equipment

c) Return on Investment

Rate of discount which reduces the present value of five annual inflows of $55,000 to $150,000 or 24% +

d) Net Present Value

Five annual inflows of $55,000 discounted at 10% and compared to a $150,000 investment outlay of $58,450

The usual main difference between accrual and cash flow accounting is depreciation. Depreciation is an expense under accrual accounting via the philosophy that the cost of an asset should be allocated to its useful life, as the asset is used, even though all of the cash paid for the asset may be paid out at the beginning of the asset's useful life. Depreciation is not considered an expense under cash flow accounting, since depreciation as such involves no cash outlay. However, the impact of depreciation deductions on outlays for taxes is recognized in the cash flow method.

In succeeding pages the two accrual techniques and the two cash flow techniques will be illustrated.

In order to fully assess the profitability of the new product, the $25,000 incremental income should be related to the incremental average investment of $75,000 as shown in Exhibit I, above. Under the return on investment concept these two items are related as a percentage; i.e., the $25,000 incremental annual income is 33⅓ per cent of the incremental average investment of $75,000. Under residual income the same two items are related by charging the required return (10 per cent) on the average investment ($75,000) to the income statement in the form of interest[3] ($7,500).

Accrual return on investment and residual income represent two distinct ways to present the same data in order to evaluate an investment decision. In both instances the required return is 10 per cent after taxes. Under return on investment the estimated return is determined (33⅓ per cent) and compared to the required return in order to make a decision, while under the residual income concept the residual income is determined by charging the required return to the income statement in the form of interest in order to make a decision.

A return on investment (33⅓ per cent) in excess of the required return (10 per cent) and a positive residual income, in essence, represent the same thing even though they are expressed in different ways, that is, one is expressed in percentage terms while the other is expressed in terms of dollars. Alternatively one might say that the favorable nature of the proposed investment can be expressed in terms of the 23⅓ per cent return in excess of the required 10 per cent return or the $17,500 residual income. A quick calculation will indicate that 23⅓ per cent of the average investment ($75,000) equals the $17,500 residual income.

Exhibit II, at left, indicates the methodology of determining cash flow evaluations for capital expenditure decisions.

What was said above concerning the two accrual methods can also be said for the two cash flow methods; i.e., cash flow return on investment and net present value represent two distinct ways to present the same data. Return on investment concentrates on the return in excess of the required return as a percentage while net present value deals with the same differential expressed in dollars.

An interesting comparison at this point would be the relationship between the two accrual methods and the two cash flow methods of evaluating investment proposals. The net present value method and the residual income method are in essence the same method except for the difference between cash flow and accrual methodology. Both dollarize the amount of return in excess of the required 10 per cent return.

The return on investment method as applied to either cash flows or accruals is also essentially the

[3] In the early part of this century such an interest charge represented quite a controversial item under the title of "imputed interest."

same. Greater appreciation of this similarity can be attained by remembering that the cash flow return on investment is determined by finding the rate of discount which makes the net present value of a proposal equal to zero. The accrual rate of return can also be thought of in the same terms, since the accrual rate of return is that rate of interest applied to investment which will make residual income equal to zero.

As will be made clear, the payback technique has a number of variants. In its simplest sense it is a measure of how quickly (in terms of years) an investment outlay will be recouped via the net cash inflows[4] from the investment. The necessary calculations are as follows:

$$\text{Simple Payback Period} = \frac{\text{Incremental Cash Investment}}{\text{Annual Net Cash Inflow}}$$

$$= \frac{150{,}000}{55{,}000}$$

$$= 2.73 \text{ years}$$

A payback of 2.73 years indicates that the company will recover its $150,000 initial outlay in a little more than two and one-half years.

The main difficulty with the above payback calculation is that it makes no allowance for earnings requirements, i.e., the required 10 per cent return on investment. This difficulty is what prompts most people to reject the "simple payback calculation" as a criterion for judging the worth of an investment proposal.

In recent years a very interesting variation of payback has been proposed.[5] The variation introduces the required rate of return into the payback calculation in order to derive the payback period in discounted terms. The concept is very simple and the calculations involved represent a slightly different arrangement of the same calculations made when determining net present value. Calculations are as shown in Exhibit III, above. The ultimate net present value at the end of Year 5, $58,450, is the same as calculated earlier, but the cumulative year by year net present value indicates at what point in time the $150,000 Year 0 outlay is recovered in terms of inflows discounted at the required earnings rate of 10 per cent. Examination of the "Cumulative Net Present Value" column indicates that the discounted payback period is between three and four years. At the end of the third year the cumulative net present value is negative, but the discounted inflows for the fourth year convert the negative net present value to a positive amount by the end of the fourth year. Thus, for the present project one can state that the discounted payback period is three plus years or approximately 3⅓ years if one assumes that the discounted inflows of Year 4 are received evenly throughout Year 4.

A comparison of the simple payback with the discounted payback has to be in favor of the discounted payback since the discounted payback recognizes the required earnings rate in determining how long it takes to recoup an investment outlay. The discounted payback is actually the "breakeven" useful life of the project, which can be a very useful bit of information to those charged with approving investment proposals. The simple payback presumes to be a breakeven useful life, but it is not since it ignores the required earnings rate. From a realistic point of view one must reject the simple payback (2.73 years) since at a useful life of 2.73 years the project under consideration is a loss project. Only when the project reaches its discounted payback life can it be considered a candidate for profitable investment of funds.

A useful addition to the concept of discounted payback is the dis-

EXHIBIT III

Years	Present Value Factors @ 10%	Cash Flows	Discounted Flows	Cumulative Net Present Value
0	1.000	($150,000)	($150,000)	($150,000)
1	.909	55,000	49,995	(100,005)
2	.826	55,000	45,430	(54,575)
3	.751	55,000	41,305	(13,270)
4	.683	55,000	37,565	24,295
5	.621	55,000	34,155	58,450

EXHIBIT IV

Years	Cumulative Net Present Value	Per Cent Recovered
0	($150,000)	—0—
1	(100,005)	33.3
2	(54,575)	63.6
3	(13,270)	91.2
4	24,295	116.2
5	58,450	139.0

WILLIAM L. FERRARA, CPA, is professor of accounting at the Pennsylvania State University. He is a member of the Board of Examiners of the AICPA and a national vice president of the NAA. Dr. Ferrara serves on the faculty of the Graduate School of Sales Management and Marketing sponsored annually by Sales and Marketing Executives-International at Syracuse University. His research has been published in many professional journals and he is co-author of **Management Accounting for Profit Control,** published by McGraw-Hill.

[4] One could compute payback in accrual terms. This, however, doesn't appear too fruitful since the notion of payback is implicitly, if not explicitly, cash flow oriented.

[5] Rapapport, Alfred, "The Discounted Payback Period," *Management Services*, July-August, 1965, pp. 30-36.

counted payback profile. This profile results from a calculation of the percentage of an investment outlay recovered cumulatively during its useful life. The percentages are shown in Exhibit IV, page 51, for the project under consideration.

These percentages can be used as they are or they can even be plotted in graph form. The total percentage recovered is usually referred to as the "profitability index," which has been considered by some to be a useful criterion for ranking alternative investment proposals.[6]

The utility of the discounted payback profile is quite obvious, whether it be prepared in tabular or graph form. An evaluation of alternative investment proposals with approximately the same net present value or cash flow return on investment could be greatly facilitated by knowledge of both the discounted payback (break-even) period and the discounted payback profile.

Human nature is such that it always seeks to simplify or make routine the decision making process. In the context of capital expenditure decisions there seems to be an urge to come up with the "one best" method of financial evaluation which embodies a single criterion. The philosophy to be expressed here is that there is no single criterion, such as net present value or accrual return on investment, even though there might be a best basic method, i.e., cash flow or accrual.

The choice between cash flow and accrual methods is not as clear as it first appears, since the choice depends upon whether we consider financial evaluations as "applied economics" or "applied social psychology."[7] As used here "applied economics" refers to evaluations which ignore the fact that men will make decisions in accordance with their own selfish interests. Alternatively, "applied social psychology" refers in the present context to the plight of the executive who is convinced that cash flow methods are most appropriate for his evaluation of capital expenditure decisions while he is simultaneously aware of the fact that his performance will be evaluated via earnings per share or operating income calculated in non-cash-flow terms, i.e., via accrual accounting. The consideration of financial evaluations from the viewpoint of "applied social psychology" is more commonly referred to as the "behavioral point of view."

Economics vs. psychology

In succeeding pages the "cash flow vs. accrual" issue will be considered from both the applied economics and behavioral points of view. Then by way of conclusion some more useful perspectives can be developed.

The choice between accrual and cash flow methods is not a difficult choice in a conceptual sense from the applied economics point of view. Accrual methodology is not preferred because it does not consider the time value of money.

Accrual methodology does not consider the time value of money, essentially because it ignores the fact that depreciation does not involve an outlay of cash. The outlay of cash for depreciable assets usually occurs at the point of purchase. Another facet of how the accrual method does not consider the time value of money relates to the fact that the accrual method does not recognize that monies received in different years cannot be considered equivalents.

The reason for concentrating on the time value of money relates to the concept of opportunity costs. Money does have value in that it can be invested, even for very short periods of time. The return that monies invested can earn is the opportunity cost of money. In the present context we asssumed that the opportunity cost of money was 10 per cent after taxes, i.e., the firm could invest all available resources and earn at least 10 per cent.[8] Therefore, any project that does not yield 10 per cent is considered financially undesirable.

An advocate of the accrual method could respond to the above allegations by stating that the accrual method does consider the opportunity cost of money via return on investment and residual income. The whole idea of the accrual return on investment calculation is to compare earnings on a project with earnings which can be obtained elsewhere (10 per cent). The whole idea of residual income is to include as an opportunity cost in the income statement the return on investment which can be earned elsewhere. Thus the advocate of accrual methods could argue that accrual methods do provide for the opportunity cost of money.

The response to the above imaginary advocate of accrual methods is not difficult. It is as follows:

> Even though the accrual method provides for consideration of the opportunity cost of money, it does so in too limited a sense. *Proper consideration of the opportunity cost of money requires that the incremental costs, revenues, and investment be stated in terms of cash, the resource to be invested.* Expression of incremental costs, revenues, and investment in terms of cash is the essence of the cash flow method.

After one decides that the cash flow method is the best basic method (from the applied economics point of view) for financial evaluation of capital expenditure pro-

[6] Anthony, Robert N., *Management Accounting: Text and Cases,* 3rd Ed., R. D. Irwin, Inc., Homewood, Illinois, 1964, pp. 636-638.

[7] The author first encountered these useful terms in the interesting article by Robert N. Anthony, "Framework for Management Planning and Control," *Management Services,* February-March, 1964, pp. 18-24.

[8] The basic considerations involved in determining the opportunity cost of money, i.e., the minimum desired return (often referred to as the "cost of capital"), can be found in most texts on management accounting or financial management.

posals, one must consider how to work with the variety of techniques available under the cash flow method. Unfortunately most discussants of cash flow technology attempt to justify one cash flow technique as better than others. The position to be taken here is that each of the three cash flow techniques illustrated earlier should be a part of every capital expenditure evaluation; i.e., net present value, cash flow return on investment, and discounted payback (including discounted payback profile) should be considered for every project.

Each of the three cash flow techniques emphasizes a different dimension of the financial evaluation. Net present value emphasizes the scale of the project in Year 0 dollars; cash flow return on investment emphasizes the percentage return; while discounted payback emphasizes the project's breakeven point in years.

Arguing that one of the techniques is superior to the others is in essence saying that it is best to concentrate on scale or percentage return or breakeven (recouping investment). Such an argument is spurious since it ignores the fact that each dimension provides a useful view of the project that the other dimensions do not. The extra cost involved in deriving three cash flow measures, rather than one, will not be significant, since in essence the three measures represent three different arrangements of the same data.

From a behavioral point of view the choice between accrual and cash flow methods leans rather heavily in favor of accrual methodology as long as the profitability of the total firm or its parts (profit centers) is measured in accrual terms. The basis for this conclusion is that organization decision makers will inevitably tend to make decisions in accordance with the methodology used to evaluate their performance. If decision makers are evaluated in accrual terms (they are in the overwhelming majority of cases in business today) one can only expect them to keep a close watch on forecasted accrual performance for decision making while they go through the mechanics of a mandated cash flow evaluation.

The incongruous nature of a situation wherein decision making and performance evaluation are on different wavelengths can be illustrated by the following non-hypothetical situations:

> In a replacement decision will gains or losses on disposition of equipment be ignored, except for tax consequences, since they have no impact on cash flows or will they inevitably be considered since they will have an impact on the income statement? Remember that an income statement is a significant part of the evaluation of management.
>
> There is at least one major company which has a policy of evaluating major capital expenditure proposals via cash flow techniques, but the final decision is made only after the impact of the expenditure program on projected earnings per share is also evaluated.

The behavioral considerations discussed here have led some to recommend that performance evaluations be made in cash flow terms in order to bring decision making and performance evaluation methods into conformity. For example, both Anthony and Solomons move in this direction with regard to accounting for property, plant, and equipment.[9]

Dearden, on the other hand, recommends some adjustments to or specific variations of accrual methods to make them conform better

Unfortunately, most discussants of cash flow technology attempt to justify one cash flow technique as better than others. The position to be taken here is that each of the three cash flow techniques should be a part of every capital expenditure evaluation; i.e., net present value, cash flow return on investment, and discounted payback should be considered.

[9] Anthony, Robert N., "Accounting for Capital Costs," included in *Management Control Systems* by Robert N. Anthony, John Dearden, and Richard F. Vancil, R. D. Irwin, Inc., Homewood, Illinois, 1965, pp. 343-348; David Solomons, *Divisional Performance: Measurement and Control*, Financial Executives Research Foundation, New York, 1965, pp. 134-143.

. . . it is easy to conclude that cash flow methods are superior to accrual methods in the case of capital expenditure decisions . . . but, when the relationship between decision making and performance evaluation is considered, one can legitimately move in the direction of considering a conclusion that accrual methods are superior to cash flow methods. . . .

to cash flow concepts in the case of divisional profit reporting.[10] For example, he recommends adoption of the composite depreciation method in order to eliminate the possibility of gains or losses on the disposition of assets.

Lerner and Rappaport suggest that the answer might lie in constraining cash flow decision methodology through the imposition of an accrual earnings requirement.[11] Thus, one might accept a less than optimal group of investment proposals measured in cash flow terms in order to enhance the opportunity to attain a designated accrual earnings growth rate. On his own, Rappaport suggests that the basic problem may reside "in the accrual accounting measurement model which must somehow be reconciled with the economic present-value model."[12]

Another possible approach is to determine if there really would be a difference in the go—no go nature of capital expenditure decisions and/or the ranking of alternative capital expenditure proposals depending upon whether cash flow or accrual techniques are used. If in most instances there would be no difference in the decision or the ranking, one could then argue that capital expenditure decisions be based upon accrual methods in order to have conformity between decision making and performance measurement techniques. The alternative of using cash flow methods for performance evaluation while retaining the theoretically sound cash flow approach to decision making does not appear to be a real alternative, at least for many years, due to our fondness for accrual concepts in performance reporting.

The preliminary results of a simulation study tend to support the idea that there wouldn't be much difference in the decision or the rankings via accrual or cash flow techniques.[13] Thus the apparently odd conclusion of basing capital expenditure decisions upon accrual methods may actually be the most rational conclusion from a behavioral point of view. This is especially true if accounting information is to be truly utilitarian.

Disregarding the inevitable relationship between decision making and performance evaluation, it is easy to conclude that cash flow methods are superior to accrual methods in the case of capital expenditure decisions. Furthermore it is not too difficult to conclude that such specific cash flow techniques as return on investment, net present value, and discounted payback should be considered complementary since they each emphasize different and important dimensions of proposed capital expenditures.

When the relationship between decision making and performance evaluation is considered, one can legitimately move in the direction of considering a conclusion that accrual methods are superior to cash flow methods. The basis for this statement is that performance evaluation is usually based upon accrual techniques and that there may be no difference in the go—no go nature and/or the rankings of competing proposals whether they are evaluated via accrual or cash flow methods. If further research indicates a lack of significant difference between cash flow and accrual evaluations, then such specific accrual techniques as return on investment, residual income, and perhaps an accrual version of payback should be considered useful parts of the total package of information to be presented to a decision maker.

[10] Dearden, John, "Problem in Decentralized Profit Responsibility," *Harvard Business Review*, May-June, 1960, pp. 79-87.
[11] Lerner, Eugene M., and Alfred Rappaport, "Limit DCF in Capital Budgeting," *Harvard Business Review*, September-October, 1968, pp. 133-139.
[12] Rappaport, Alfred, (ed.), *Information for Decision Making*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1970, p. 311.
[13] MBA Research Project in process by Scott Edwards, The Pennsylvania State University, College of Business Administration. The preliminary results of this study must be considered no more than tentative and suggestive.

what people are writing about

BOOKS

Analysis of Behavioral Systems by JAMES R. EMSHOFF, The Macmillan Company, New York, 1971, 147 pages, $6.95.

Efforts to build quantitative models for analysis of problems involving human behavior have not been very successful to date. This author tells why and offers an approach that he considers more likely to be productive.

Operations research, systems analysis, and related fields of study have achieved some spectacular successes in such diverse areas as the blending of petroleum and food products, inventory control, and transportation routing. Much less progress has been made in applying these methods to problems where the solution requires models that provide an explicit understanding of the behavior of people.

In this book Dr. Emshoff, an independent consultant, explains why the current methods of the "systems sciences" are unsuitable for behavioral studies, outlines a method that he says would be suitable, and describes the results of a study conducted according to the principles he expounds. (In the "systems sciences" he includes OR, management science, and systems analysis. All, he says, are essentially the same thing; all use the concept of a model as the basis for problem solving. However, systems analysts "tend to use a model to identify a problem as well as to solve it, whereas operations research/management science tend to formulate the problem prior to developing a model.")

The systems sciences, he concedes, have dealt to some degree with problems that include behavioral factors, but these problems have tended to be ones in which human choice plays a minor role (for example, production) or in

which the numbers of people were large enough for statistical probabilities to apply (for example, waiting lines). In all these cases it has not been necessary to consider *why* men in the system make the choices they do; what has mattered is *what* they do.

Behavior important

Now, however, systems scientists are getting interested in activities such as marketing, research and development, urban problems, and long-range strategic business planning. Problems like these require control over aspects of behavior, and that control depends on the extent to which human behavior is understood and can be explained.

Partly because of their heavy emphasis on statistical theory, operations researchers have tended to be output-oriented in their studies. (Dr. Emshoff defines output-oriented as meaning that "the analysts were primarily concerned with how to represent interaction among the input variables in the model so that the output of the model would be similar to that of the real system.")

In problems involving human choice, Dr. Emshoff points out, inputs to the model, that is, the causes of the behavior, are at least as important as the output produced by the model. Output-oriented research, he says, has been unsuccessful in solving marketing and other human-oriented problems because it results in a model that describes the choices people make, and description provides only knowledge—not understanding—of behavior.

Research strategy proposed

Dr. Emshoff goes on to present a proposed strategy for behavioral research. Essentially, it calls for thorough study of small segments of behavior, whose results can then be integrated sequentially. This was the method applied in the Wharton School's six-year "conflict project," (a study of the general problem of controlling the escalation of conflict situations), which is described in the latter part of this book. The use of this method, the author feels, was the principal reason for what he considers to be the success of this project.

As can be seen from this description, Dr. Emshoff's book is a highly technical one in the sense that it contains no easily adaptable bag of tricks. His prescription, rather, is for more work, and it may be work that the typical business reader is unwilling or unable to undertake.

It is not, however, a difficult book to read; it contains little mathematics, and the organization structure is very clear. And it is an important book. The type of research the author is talking about represents a major frontier for the systems scientists; once it has been conquered quantitative methods will probably become standard tools in nearly every business of any size.

The Administrative Revolution: Notes on the Passing of Organization Man by GEORGE E. BERKLEY, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1971, 181 pages, $5.95 (clothbound), $2.45 (paperbound).

Only a few decades after the publication of The Organization Man, *this author, an assistant professor of political science at Northeastern University, attempts—with some success—to prove that the character it personified, as well as the forces that shaped him, is now obsolete.*

The growth of bureaucracy, culminating in the stereotype of the organization man as painted by William F. Whyte, Jr., has not always been viewed with the disapproval it draws today, this author reminds us in his opening chapter. As compared to the capricious despotism it replaced, bureaucracy had the practical and human advantages of rationality, impartiality, and (relative) efficiency.

Today, however, bureaucracy is losing popularity, not only among the radical young and the clients of government but also in its heartland, business. There, says Professor Berkley, the traditional pyramid is crumbling, to be replaced by something like a "squishy circle," and the organization man is giving way to "Mobicentric Man."

Reasons why

The reasons are many: the allegedly growing influence of Theory Y and other human-relations-oriented theories; the alleged growth of participative management and profit sharing in response to union pressures; the success with which some companies are applying management by objectives; and the increase in numbers and power of staff (as distinguished from line) personnel and consultants, the need for more intercommunication among elements of a business, and the popularity of the project group type of organization—all results of increased technology.

"The growth of education," says Professor Berkley, "provides the main thrust for the administrative revolution. Combined with the gowing need for innovation, specialization, and professionalization, the emergence of educational (*sic*) man is slowly but surely spelling the doom of organization man."

Trend praised

This trend is altogether a good thing, in the author's view. In addition to becoming looser and more open, organizations (business and other) are becoming much more integrated with society's goals. And the work organization, by providing such things as medical care, marriage counseling, recreational programs, and education, shows signs of replacing what the organizational revolution destroyed: the supportive functions of such traditional institutions as the family, the neighborhood, and the church.

It would appear that in this book Professor Berkley is hoping he has another *The Organization Man.* It seems unlikely that he does. For the reader employed in a business organization Whyte's book carried the shock of recognition; he suddenly realized that the things described were all around him.

That is not the case with this book. Despite a lavish journalistic-style use of quotes and concrete examples, Professor Berkley does not succeed in proving that his administrative revolution has become universal or even reasonably common. He does establish that such a trend exists; whether it will become the dominant one remains to be seen. Meanwhile, however, this remains a lively, entertaining, and provocative book.

Automation and Alienation: A Study of Office and Factory Workers by JON M. SHEPARD, the M. I. T. Press, Cambridge, Massachusetts, 1971, 163 pages, $7.95.

Do the automatic factory and the computerized office turn workers into bored automatons, as many have feared? This author found quite the contrary, in the study reported in this book, but his evidence, at least where office workers are concerned, is highly debatable.

Job specialization may be the most efficient way to organize work, but it results in a loss of meaning in work for the employee, as innumerable sociological and psychological studies have shown. Both trends—specialization and loss of pride—have continued steadily since the beginning of the Industrial Revolution, with the growth of mass production in both plant and office.

Now comes automation. Although it might at first glance seem to be a continuation of mechanization—only more so—in terms of the worker's relationship to his job it is actually quite different, many sociologists feel. By eliminating and consolidating jobs it broadens the duties and increases the responsibilities of the workers who remain.

Clerical work stressed

A number of factory research studies support this thesis. Less information has been gathered about the effect of automation on clerical job structure. In this book, one of a series of research studies on the impact of computers conducted by the Industrial Relations Section of the Alfred P. Sloan School of Management at Massachusetts Institute of Technology, the author, a sociologist teaching at the University of Kentucky, reports how he tested this hypothesis in studies of five clerical work situations and, by way of comparison, two industrial plant situations.

Workers whose attitudes were studied were selected to represent the three basic man-machine relationships (nonmechanized production, mechanized production, and automation) characteristic of the major stages of technological development. The factory workers were employed in an oil refinery and an automobile assembly plant; the office workers were employed in a large bank, a large insurance company, and four small insurance companies. Data on which the production workers' alienation indexes were constructed were obtained by interview; the office workers filled out questionnaire forms.

Workers compared

Attitudes of assembly-line-machine operators (mechanized workers) in the automobile plant were compared with those of automobile maintenance craftsmen (craft or nonmechanized) and process instrument monitors in the oil refinery (automated). In the office studies secretaries and clerks whose jobs were not machine-dominated were used to represent the craft or nonmechanized phase of technological development; operators of special-purpose machines (such as keypunch operators and production typists) represented the mechanization phase; and computer operators, computer programers, and systems analysts were used to represent the automation phase.

Feelings measured

Characteristics of alienation include feelings of powerlessness, meaninglessness, and norm-lessness in work; lack of self-evaluative involvement in work; and instrumental work orientation (viewing work as a way of merely earning a living rather than as something worthwhile in itself). These were the feelings measured in the attitude survey.

Among the factory workers, feelings of alienation were low among the skilled automobile maintenance workers, reached a peak among final assemblers in the same factory, and declined among monitors in the oil refinery to a point even lower than that of the craftsmen on all scales except that of powerlessness. This finding is more or less consistent with those of other blue-collar studies.

Results complex

The results for the office workers were more complex. For them no overall index of alienation could be calculated, for within each work group there were differing results for each component of the alienation scale; for example, computer operators scored highest of all groups in feelings of powerlessness and lack of self-evaluative involvement; nonmechanized clerks were highest in instrumental work orientation; nonmechanized clerks and mechanized office workers tied for first (above the automated workers) on feelings of meaninglessness; and mechanized office workers had a clear-cut lead in only one category, lack of self-evaluative involvement. Furthermore, there was little relation between the feelings of the two groups in the automated category, except for involvement; in terms of the other components of alienation computer programers

and systems analysts scored far below computer operators.

The author seems to believe that these findings for the clerical workers nevertheless reinforce his main thesis, and he offers some elaborate interpretations to justify this conclusion.

To the reader a more obvious reason for the discrepancies leaps out: a poor choice of job categories for comparison. The selection of general clerical workers as the equivalent of skilled mechanical craftsmen seems far-fetched; so does the lumping of computer operators, programers, and systems analysts under a single classification of automated employees. Studying programers and systems analysts as the equivalents of instrument monitors in a power plant shows little understanding of the structure and requirements of EDP jobs.

It may be true that increasing automation will decrease alienation in the office as well as in the plant, but it cannot be proved by studying the attitudes of programers and analysts, who hardly qualify as upgraded clerical workers. The issue awaits further study by someone with a clearer understanding of the nature of the various types of work.

Briefly listed

How to Be a Boss by AINSLIE MEARES, M.D., Coward-McCann, Inc., New York, 1971, 249 pages, $6.

The author of this book is an Australian psychiatrist, and the subtitle of the American edition is "A Practicing Psychiatrist on the Managing of Men." The author classifies as major personality characteristics extrovert, introvert, obsessive, and hysteric and describes them. He also tells how to cope with anxiety, hostility, and depression in one's self and in others, how to communicate with individuals and groups, how to obtain information from others who are reluctant to give it, how to persuade, how to maintain morale in one's self and in a business, and how to cope with retirement. A chapter entitled "Women on the Way Up" discusses the executive's wife and what she can do to help as well as the problems of the woman executive. The final chapter deals with the question, "What is success?"

Listen, Management! by WILLIAM F. KEEFE, McGraw-Hill Book Company, New York, 1971, 200 pages, $8.95.

This guide by an industrial communications consultant carries the subtitle, "Creative Listening for Better Managing." It treats listening as a communications specialty deserving the same attention as speaking, reading, and writing. Among the subjects: the danger of failing to listen effectively, how to develop the mental attitude required for effective listening, how to eliminate common barriers to good listening, how to separate facts from feelings, how to establish rapport with others, and how to listen through emotion and conflict.

Survey of Patent Development and Marketing Organizations, TTA Information Services Company, 4 West Fourth Avenue, San Mateo, California 94402, 1971, 30 pages, $15.

This is a directory of organizations that engage in refining patents and products for commercial markets and assist manufacturers, research departments, management and technical consultants, universities, and inventors in locating companies willing to market their products. Ninety organizations are listed; 56 are profiled.

The Impact of Information Technology on Management Operations by WILLIAM HOUSE, Auerbach Publishers Inc., Princeton, New Jersey, 436 pages, $15.

Twenty-six articles by 29 contributors (some of them CPA consultants) survey recent developments in data processing and their impact on organizational structure, decision making, planning, and control. Technological trends reviewed include hardware, software, systems engineering, data communications, and time sharing. Other topics include mathematical models, on line processing, and management information systems.

Effective Management Selection: The Analysis of Behavior by Simulation Techniques by CABOT L. JAFFEE, Addison-Wesley Publishing Company, Inc., Reading, Massachusetts 01867, 1971, 150 pages, $12.50.

This book explains how to use simulation (game playing, role playing, in-basket exercises, etc.) in testing candidates for supervisory positions. There is little actual discussion of the subject; most of the book consists of sample exercises, score sheets, validation studies, and the like. There also is an order blank for a complete "assessment center program for supervisory selection" designed by the author and marketed by the publisher.

The Engineer in the Industrial Corporation by R. RICHARD RITTI, Columbia University Press, New York, 1971, 266 pages, $10.

Dr. Ritti, a professor at Pennsylvania State University, finds widespread dissatisfaction among engineers in industry and government, particularly in systems development organizations. He traces it to low influence over technical programs and to problems of skill utilization, especially under-utilization. He offers some suggestions for a management system that matches the requirements of the work and the use of engineers in roles more consistent with their expectations.

Managing People at Work by DALE S. BEACH, The Macmillan Company, New York, 1971, 515 pages, $6.95 (paperbound).

This anthology, subtitled "Readings in Personnel," contains 45

articles on various aspects of personnel by personnel administrators, professors, journalists, and others. General areas covered include the nature of the personnel function, organization, employment (with two articles on employment of the "culturally deprived"), performance appraisal, training and development, motivation, styles of management, leadership and supervision, morale and attitude studies, participation programs, communication, discipline and grievance handling, compensation, health and safety, collective bargaining, and ethics and social responsibility.

MAGAZINES

Overhead Allocation Via Mathematical Programming Models by ROBERT S. KAPLAN and GERALD L. THOMPSON, *The Accounting Review,* April, 1971.

The authors present a procedure for allocating overhead which combines the desirable features of both absorption and direct costing.

In this article Professors Kaplan and Thompson introduce a novel approach to overhead allocation. Their method utilizes linear programing formulations as a primary tool, with suggested integer programing extensions.

A brief review of the advantages and disadvantages of both full and direct costing provides the launching platform for development of the basic model.

Allocating common overhead

Initially all overhead costs are treated as joint costs. As such they are allocated to products in a manner that maintains the relative profitability of the products in the optimal solution.

Under certain restrictive assumptions, some of which are subsequently relaxed, the initial primal and the corresponding dual linear optimization problems are formulated. A numerical example is presented and utilized throughout the article to demonstrate the procedures. Rule 1 is formulated for the allocation of common overhead. In effect, this rule states that common overhead is to be allocated in proportion to the gross profit of each product. The optimal values of the dual variables under this formulation are relevant for decisions on acquiring additional amounts of scarce resources.

Allocating traceable overhead

Since it is probable that some overhead can be identified as associated with the provision of specific resources, the authors develop Rule 2 for allocating such traceable overhead. B'_i is introduced as the per unit charge for use of Resource i so that products using this resource are not charged for more than either the marginal value or the average unit cost when using that resource. The authors then modify the initial primal and dual problems to include the unit charges attributable to the use of the scarce resources. Under Rule 2 a traceable overhead charge of B'_i is assigned for each unit of Resource i used in producing a good. Common overhead remaining after allocation of traceable overhead by Rule 2 is then allocated via Rule 1.

Interdependencies

The authors show how the model can be modified for other types of constraints that recognize interrelationships among products in addition to scarce resource usage.

The numerical example is extended to illustrate a situation in which one product receives a negative overhead charge, or overhead subsidy, because its production and sale are needed for the production and sale of another product. The claimed advantages of this method of overhead allocation are these: "The existence of sales interdependencies is explicitly recognized and a better measure of the true profitability of products is obtained; i.e., those products whose sales depend upon the production and sale of other goods are made to bear an increased share of overhead while those products whose sale leads to increased sales of other products receive a subsidy to reflect this value."

A similar result (i.e., a partial overhead subsidy) is obtained when the numerical example is modified to include a managerial constraint on production. The authors show that the proposed method prevents a product from being adjudged unprofitable as a result of top managerial dictates. Such a result may be important for companies using profit center reporting. The authors state that their procedure ". . . gives a rationale for deciding on the size of a subsidy payment to such a division to recognize its contribution in achieving the company's goals."

Avoidable costs

Escapable or avoidable overhead refers to those overhead charges which would be eliminated if a product were not produced or if a facility were shut down. In the last section the authors show how such costs can be handled in much the same way as the previous kinds of overhead charges.

They point out that an integer programing formulation rather than a simple linear programing model is required for problems of this sort. The authors describe the model mathematically and then assume that the solution is available in order to proceed with the overhead allocation problem per se. A linearized problem (and numerical example) are presented showing allocation of avoidable overhead. Rule 3 sets forth the procedure for (1) allocating fixed costs associated with positive production of a given product and (2) assigning avoidable costs associated with the use of a given facility. This manner of assigning avoidable overhead does not distort the optimal solution to the linearized problem. Avoidable costs not allocable under Rule 3 must be treated as common over-

head and allocated under Rule 1.

The accountant or management consultant with interest in mathematical models can benefit from study of the overhead allocation procedures presented by Professors Kaplan and Thompson in this introductory paper. Their method does not introduce distortions in the relative profitability of products, and it recognizes scarce resource utilization and production and sale interdependencies. Verifiability is increased by the use of linear programing models which specify shadow prices for scarce resources without reliance on intuition or unspecified assumptions.

JAMES H. BULLOCK, CPA
Oklahoma State University

Accomplishment / Cost: Better Project Control by ELLERY R. BLOCK, *Harvard Business Review*, May-June, 1971.

How to measure progress on a project in terms of both technical accomplishment and cost continues to be a problem for major contractors. This author outlines a solution.

If expenditures on a project are running ahead of budget, does that mean that project accomplishment is correspondingly ahead of schedule? This is the crucial question for management, but, says Mr. Block, current progress-reporting techniques do not provide the data needed to answer it.

PERT/Cost, Line of Balance/Cost, and other tools of project control have three major drawbacks, in his view: They do not correlate cost with overall schedule accomplishment. They foster inaccuracy by trying to report and predict cost for each conceivable task; the resulting paperwork burden on the busy project manager encourages him to cut corners on his own estimates. Report displays are awkward; by presenting too many variables all at once, they make it difficult for management to evaluate what is going on.

In this article Mr. Block presents a new method of project control, the Accomplishment/Cost Procedure (ACP), which, he says, eliminates all these drawbacks. Essentially, it consists of graphing actual and budgeted cumulative accomplishment against actual and budgeted cumulative cost, with accomplishment sharing the time axis. The gap between the actual and budget lines then measures the degree to which the project is running ahead of or behind the plan.

Value assigned

Each task is assigned an accomplishment value. In the example given by the author, each $10,000 of the budget for that task was given the value of one unit of accomplishment; the degree of value added and the degree of difficulty to attain are suggested as possible alternatives. Accomplishment values, the author warns, should correspond with the relative contribution of each milestone rather than the length of the time period during which the milestone is to be accomplished. When progress is being measured, accomplishment values should be accumulated only for completed tasks.

Progress reported

Progress is reported through one or two indexes. The principal one, average cumulative accomplishments, is calculated by determining which tasks have been completed, summing the appropriate preassigned unit values, and noting the progress gained for each function. A curve of actual performance is then drawn through the points plotted from a number of reporting periods. If there seems to be risk that tasks ahead of schedule will mask lagging tasks sufficiently to make the average accomplishments misleading, a second index, slippage units, may be used. Slippage units are calculated by summing up negative (lack of progress) units between planned and actual progress.

This technique, Mr. Block reports, worked well in monitoring performance on a project aimed at development and production of a radar altimeter. The same company has also used it successfully in design engineering, drafting, industrial engineering, quality control, metal working, manufacturing assembly, inspection services, manufacturing testing, and boxing and shipping. Other possible applications suggested by the author are in the building and construction industry, shipbuilding, and computer programing.

Sensitivity Analysis and Share Valuation by D. MAUND and J. TYDEMAN, *The Australian Accountant*, December, 1970.

Sensitivity analysis can be a useful tool in the process of share valuation. The twofold procedure involves: (1) a stochastic determination by the information processor (accountant) of after-tax earnings per share as a result of changes in operating variables and (2) assessment of share prices by the decision maker (investor) through the use of the internal rate of return method as compared with the net present value method.

The primary task of management is to determine and evaluate alternative courses of action under conditions of uncertainty. In such a setting parameters can and will assume an infinite number of values. Thus, sensitivity analysis, which is used to illustrate how changes in variables will affect model outputs, can be a valuable aid to the decision maker.

To illustrate this fact, the authors develop a "sensitivity model," using a nickel mining company. The model, which contains nine discrete variables, is used to calculate after-tax earnings of concentrating operations. The upper and lower limits of the values which the variables may assume and the sizes of the incremental changes are given.

The after-tax earnings per share are then calculated for all possible combinations of values allowed within the limits prescribed. A class frequency distribution of the earnings is then compiled and the mean and variance for the distribution are calculated. Assuming a normal distribution, even though there is evidence of skewness, confidence intervals are established at the 95 per cent level, and the assertion is made that the true value of the after-tax earnings per share lies within the interval. The analysis is then extended to consider the effects on earning outcomes should a decision be made to construct a smelter. Additional variable data are furnished, and the problem is reworked as above. The results reflect the after-tax earnings per share considering both the concentrating and the smelting operations.

Procedures used

The discussion of share valuation centers on two discounted cash flow procedures, the internal rate of return method (IRR) and the net present value method (NPV). To illustrate IRR, a dividend model is used to equate the future dividend inflows with the present price an investor would be prepared to pay for one share. If the current market price of the share is less than the price he would be prepared to pay, the investor should buy. The authors maintain that the formula is useful because it focuses attention on the fact that the investor knows subjectively his desired minimum rate of return.

Earnings model

The NPV method is illustrated with an earnings model. The discount rate used is the consensus rate used in the market to discount future earnings. The authors postulate that security analysts cannot know the "market discount rate"; therefore, a "market discount rate" specified by a security analyst is no less subjective than that used by an individual investor. It would therefore seem preferable to use a share valuation method wherein values for the price an investor would be prepared to pay are calculated on the basis of varying interest rates related to estimated earnings. The investor is then in a position to compare the price he would be prepared to pay, based on his subjective rate of interest, with the present price and thereby exercise the decision making function which is rightfully his.

Formula calculated

The authors then assume a constant earnings stream, which they regard as a perpetuity, modified to take into account a four-year time lag necessary to install plant and develop mine workings. Thus the price one would be prepared to pay is determined by the formula:

$$P_s = \frac{E}{i}(1+i)^{-4} - - - - -$$

P_s is the present price he would be prepared to pay for the share;
E is after-tax earnings per share;
i is the rate of interest which equates a future flow of earnings with P_s.

Price tables developed

With the aid of this formula and the class cumulative frequency distributions of after-tax earnings per share developed earlier, two tables are developed. The first table sets forth P_s values for concentrating operations, and the second table sets forth P_s values for concentrating and smelting operations. Each of these tables discloses the following: rate of interest, worst possible value of earnings, lower value of 95 per cent confidence interval, average value of earnings, upper value of 95 per cent confidence interval, and best possible value of earnings. With these tables, a variety of investors with different expectations as to future earnings and different subjective interest rates can arrive at a price which they would be prepared to pay for a share.

There can be no doubt that sensitivity analysis is useful in this type of problem. In fact, the technique has widespread applications in manufacturing and commercial industry. However, the assumption of a unit normal distribution of the after-tax earnings to determine confidence intervals would be strengthened if a Chi-square test, for goodness of fit, were applied. Both the IRR and NPV methods should yield the same results if the investor uses his required rate of return in the NPV method rather than a "market discount rate" in discounting the future streams. The question is not one of methods but of discount rates to be used in the initial investment and in the intermediate flows. Nevertheless, the notion of shifting the investing decisions to the investor and casting the security analyst in the role of information provider is a useful one.

L. Serafino Corsini
Louisiana State University at Baton Rouge

Management Planning in Higher Education—Concepts, Terminology and Techniques by Charles A. Nelson, *Management Controls,* January, 1971.

Colleges and universities are finding themselves the targets of mounting criticism and pressure for change from all quarters of society. Questions are being raised about virtually all aspects of their operation. At the same time, their administrators are increasingly aware of the scarcity of available resources. As a result, a growing number of colleges and universities are examining their management and planning processes in the search for solutions to their complex problems.

In this article, Mr. Nelson discusses some major management approaches and techniques, success-

ful in the business sector, that are now gaining acceptance as essential elements of the planning process in higher education. In particular, he discusses operating systems; planning, programing, and budgeting systems; management information systems; and long-range plans and planning models. In each case he considers the current state of the art and presents several observations. There are some exhibits, which are based on actual applications.

Operating systems

An operating system in an educational institution is a combination of methods, procedures, equipment, and personnel organized to accomplish a specific repetitive function such as enrollment, billing, or scheduling. Since the operating systems designed to handle these separate functions are not necessarily interdependent, various levels of sophistication and efficiency may characterize the systems in use by a single university. Such systems often lend themselves readily to computerization. While significant accomplishments have been made in the efficient performance of routine functions through the development of operating systems, systems that will simultaneously provide information for use in management control, evaluation, and planning have not reached as high a state of development. Thus, the integration of operating systems with other management systems, particularly the management information system, offers considerable potential for increased management effectiveness.

PPBS

With a program budget as its major component, a PPBS (planning, programing, and budgeting system) is a comprehensive and sophisticated planning process. The components of a PPBS include identifying general institutional goals, defining specific objectives in quantitative terms for specified time periods, grouping interrelated activities into programs organized to accomplish specific objectives, calculating the cost of carrying out these programs, establishing program budgets, and projecting the requirements and returns of specific programs over an extended time frame. In addition, a PPBS should involve explicitly considering alternatives so as to justify the selected programs, periodically evaluating current programs, and replanning or modifying programs consistent with the evaluation process.

Implementation problems

The primary problems in implementing a PPBS in an educational institution include defining programs with elusive objectives, constructing budgets for programs rather than for organizational units, and agreeing on standards for evaluating the quality of performance. Many state-supported institutions use this approach because they are required to do so by the state governments. Nevertheless, conformance with this requirement is often more a matter of form than of substance.

MIS

The management information system performs the function of collecting, storing, processing, and transmitting information needed for the operation, control, evaluation, and planning functions of management. The questions of what information is appropriate, in what form, for whom, and with what frequency are the critical elements in the MIS design. To answer these questions, a review of the organizational structure of senior management is usually necessary.

The MIS aids management in its control function by monitoring the operating systems. Accordingly, the need for efficient and integrated operating systems is apparent. Additionally, the MIS must identify standard sources of specified external and demographic data which can be fed into the system periodically. These data, together with internally generated data obtained from the operating systems, are required for the planning and evaluation functions.

Finally, the MIS should generate intermittent responses to specific inquiries as well as routine reports. The routine reports would cover, among other things, the academic program, students, faculty, support services, facilities, and finances. Additional reports providing updated projections for several years in advance can be generated for use in long-range planning. A major contribution of the MIS should be the periodic presentation of data in such a way as to raise internally the questions now being brought to the attention of educators by society at large.

Progress slow

An investigation into present practice reveals that many alleged management information systems are at best partial systems or merely modernized operating systems. The absence of guidelines for systems development and the cost of systems design are among the factors that have hindered further advances. Weaknesses in operating systems have also been a hinderance. But it is not always necessary to perfect the operating systems befor embarking on development of the MIS. Considerable flexibility can be allowed to best meet the exigencies of specific situations. Several complete systems will become operational shortly.

Long-range plans

Long-range planning is concerned with projections of demands and requirements over a longer period of time and at a more general level than the extended time frame feature of the PPBS. The long-range plan may be incorporated as part of the planning function of the MIS.

Planning models have received considerable application in enroll-

ment projections and other isolated segments of university operations. General simulation models covering the entire planning process for academic institutions are now feasible. Computerized simulation models revolutionize the planning process by making possible the consideration of a far greater number of alternative courses of action when a complex decision is involved.

WILLIAM C. BOYNTON
Michigan State University

Making Marketing Information Systems Work Better by STEPHENS DIETZ, *Business Management,* December, 1970.

Data banks in a computerized marketing information system can be an effective management tool, or they can be an added source of confusion if improperly utilized. The author describes the characteristics of an effective marketing information system.

The first step in making any information system work is to use the data bases properly. These raw data are processed into reports which contain mixtures of data and information. Mr. Dietz points out, "The confusion between data and information has been one of the principal reasons many executives have been burdened rather than helped by computers, because the emphasis has been on the vast quantities of data that computers can spew out."

The various data bases must be carefully analyzed for invalid, overlapping, or missing data according to the information the user wishes to receive. This information can be classified under the essentials of a news story—how, where, when, why, and who—with an added "how am I doing?"

Emphasizing this last characteristic leads into the area of exception reporting—comparing performance to plan. The author says exception reporting can be an important means of increasing the information content of reports by relieving managers of the overwhelming burden of scanning meaningless numbers. Exception reporting also improves the reporting system by providing a measure of the usefulness of these reports. The ultimate test of the data base's usefulness is management's ability to correlate the data, to apply statistical manipulations for planning and establishing operating goals. "The computer can help you do this only if the data bases are set up properly to begin with," he says.

Today's marketing management information systems primarily consist of a haphazard accumulation of data. One layer has been piled upon another with little effort being exerted to dispose of useless and obsolete data and reports. By cleansing the system and correlating the data bases, the user can improve the efficiency of the marketing operation by having all groups draw from the same basic information.

STEVEN FLORY
Louisiana State University at Baton Rouge

Earnings Retention, New Capital and the Growth of the Firm by WILLIAM J. BAUMOL, PEGGY HEIM, BURTON G. MALKIEL, and RICHARD E. QUANDT, *The Review of Economics and Statistics,* November, 1970.

This empirical study raises a basic question regarding management dividend policy. Specifically, it examines the reputed benefits to investors of earnings retention.

It has been commonly accepted that the retention of earnings by a company (ploughback) works to the advantage of the stockholders, particularly those in high tax brackets, since ordinary earnings will then be transformed into capital gains. However, if stock prices are related to earnings and if ploughback does not significantly increase earnings, then management should either improve its investment decisions or distribute current earnings as dividends.

To determine the relative impact of ploughback on companies' earnings, the authors sought to estimate the average rate of return earned on funds obtained from three separate sources: 1) new equity, 2) new debt, and 3) ploughback. They hypothesized that management makes investment decisions on the basis of the cost of obtaining additional funds. That is, if the cost of obtaining funds is relatively high, then only relatively more profitable investments will be made, since the investments will have to cover the cost of obtaining funds. The authors assert that the cost of obtaining equity funds is greater than the cost of obtaining new debt and that the cost of ploughback funds is lowest. Therefore, they predicted that they would find that the rate of return on new equity funds is greater than the rate of return on new debt, which, in turn, is greater than the rate of return on ploughback funds.

Regression analysis used

Estimates of the rate of return on investment funds were derived from regression equations where the dependent variable, change in earnings, was related to ploughback, new debt, new equity, and a risk term. Four functional forms were used for the regressions: 1) a linear additive function without a constant term, 2) a linear additive function with a constant term, 3) an additive function with a constant term and an interaction term for ploughback and new equity, and 4) an additive function with a constant term and an interaction term for ploughback and new debt. Regressions were calculated for four definitions of earnings, two definitions of ploughback, two definitions of new equity, two definitions of new debt, and two definitions of the risk measure. The regressions were each calculated with the independent variables lagged behind

earnings for the alternatives two, three, four, five, and seven years. The data for the regressions were taken from Standard and Poor's Compustat industrial tape.

The results of 32 of these regressions are reported. The authors note that the rate of return on equity capital ranged from 14 to 20 per cent, on debt from 4 to 14 per cent, and on ploughback funds from 3 to 5 per cent. These findings are in accord with the authors' original hypothesis.

The observed relatively small return earned on ploughback funds raises some interesting questions. Specifically, is earnings retention always in the best interest of investors? Is management sometimes unaggressive in its reinvestment of internally generated funds? Does management invariably strive to maximize investment return, or is this behavior a function of the source of the funds used to finance investments? The authors suggest that further research is needed to answer these questions.

SHANE MORIARITY
University of Illinois

Application of Linear Programming Analysis: To Determine the Profitability of Products Involving Joint Cost—The Plywood Manufacturing Case by LEE MENG HYE, *The Australian Accountant,* December, 1970.

Many cost allocations for inventory valuation purposes are made on the basis of relative sales value. This method is not well suited for managerial decision making. This article discusses the application of linear programing as a solution to such problems.

Mr. Hye points out early in this article that many costs are simply not known because suitable procedures have not been available for their determination. This has not been an insurmountable problem for inventory valuation since the relative sales value method can be used. He does not suggest that this is an accurate method but only that it is not too damaging when used for this purpose.

Use of the relative sales value method for decision making purposes, however, is not acceptable; it is like writing a definition in terms of the item defined. In short, Mr. Hye says, the plywood industry ". . . appears to have guessed the required product cost in arriving at the market price."

Firm vs. industry

As the author makes clear, there is a definite difference between the way a firm can view the market and the way an industry should view it. The individual firm can take the price structure as "given" whereas the industry as a whole falls more into the position of setting prices. However, even in this context the individual firm is not insulated from the need for establishing joint costs, for if it can make no such objective distinctions it will have difficulty in deciding which of several products it should make.

To illustrate the advantages and disadvantages of linear programing in solving allocation problems, Mr. Hye presents a case study from the plywood industry. He describes how the data were gathered, telling how the problem that these data were not contained in the normal accounting records was solved. As he mentions, marginal costs are usually not available from conventional records.

Application stressed

The reader does not need an intimate knowledge of linear programing to gain insight into its usefulness, for the author stresses its application rather than the manipulations involved. There is, however, an appendix with accompanying legend to guide one through the "set-up" of the problem. The problem is set up with the usual objective function and constraints. The actual manipulation of the matrix was carried out on an IBM 7040 computer using the LP III canned program.

There were three major sets of questions this linear programing analysis was designed to answer:

1. Which grades and quantities of logs to use
2. Which construction structures to use
3. Which types of panels should be produced.

In addition to supplying specific answers to these questions, the author presents a discussion of "shadow" prices and their relationship to sensitivity analysis.

This seems to be a well written and timely article. Businessmen have come to accept the fact that something other than intuition is needed in decision making, and this work adds reinforcement to that position. A knowledge of linear programing would make its message even more vivid, however. This is not a criticism of the article but rather a recognition of the responsibility each of us has to attain an acceptable level of mathematical proficiency.

E. A. DEVINE
Louisiana State University at Baton Rouge

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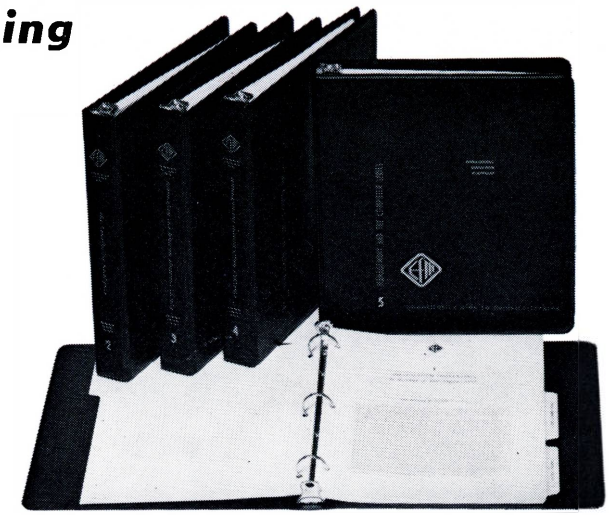

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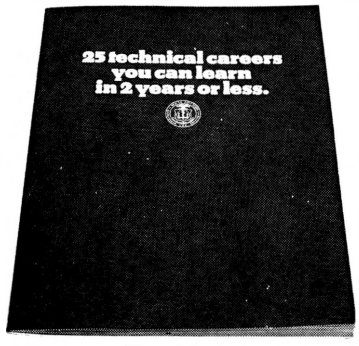

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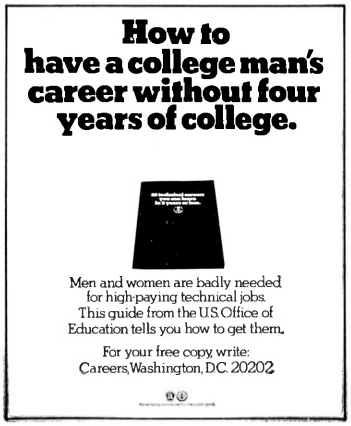

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