

# Management Services: A Magazine of Planning, Systems, and Controls

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# MANAGEMENT SERVICES

*a magazine of planning, systems, and controls*

**Pathway to Profit: The Management Information System . . . . . p. 15**

Bertram A. Colbert

**On Line-Real Time Systems for Customer Service Operations . . . . . p. 25**

Robert K. Zimmer

**Safety Stock: Key to Effective Inventory Management . . . . . p. 33**

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**Use of Sensitivity Analysis in Capital Budgeting . . . . . p. 37**

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**Advertising Control: A Computer Application . . . . . p. 41**

William T. Kelley

**The CPA's Role in Mergers . . . . . p. 49**

David F. Linowes

**The Investment of Corporate Cash . . . . . p. 53**

Edward J. Mock

*A Publication of the American Institute of Certified Public Accountants*

# Precisi

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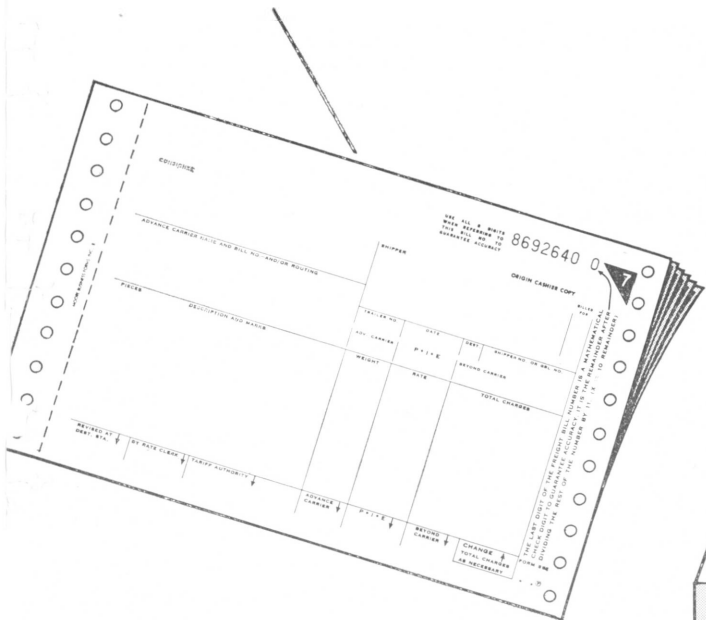


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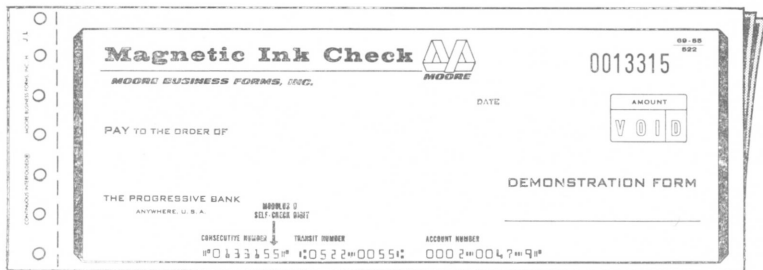
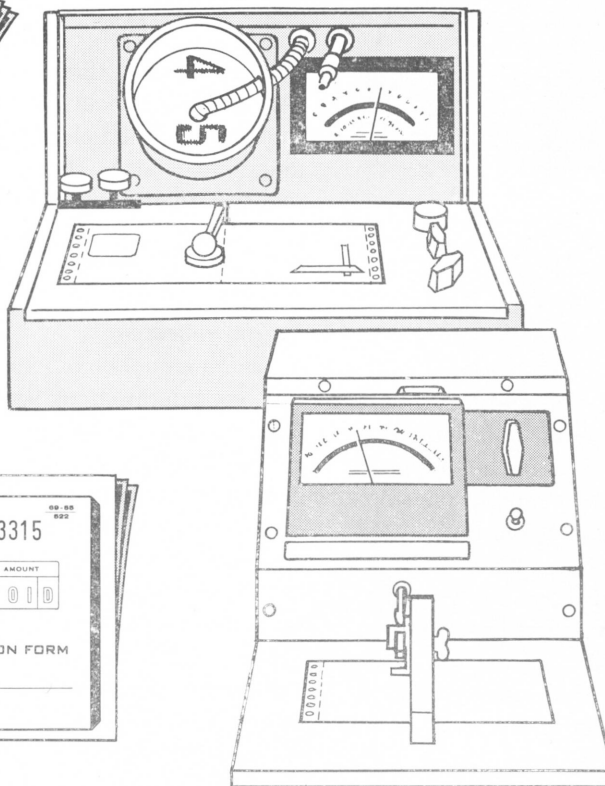
This image shows a smaller utility bill form. It includes a 'CASHIER'S STUB - PLEASE DO NOT SPINDLE, STAPLE OR MARK' section. The form has columns for 'METER READING', 'METER TYPE', 'CONSUMPTION', 'AMOUNT INCLUDING TAX', and 'DESCRIPTION'. There is a 'TOTAL' field and a 'DATE' field. The form is designed for easy data entry and scanning.

# onists

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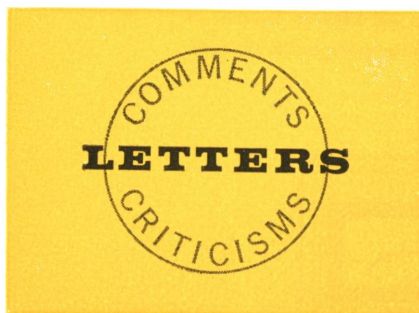


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*Still unrealistic?*

In the article, "Financial Aspects of Stock Options," by Linda H. Kistler (M/S March-April, '67, p. 23) several points seem to warrant comment. The additional consideration of stock flotation costs simply suggests that the opportunity cost to the company on stock options is less than formulated under the original model.

This modification seems trivial in light of the gross shortcomings still inherent in this model. The single most noticeable omissions are the concepts of the time value of money and discounted cash flows. Should not the stock option alternative of executive salary augmentation be considered in a time horizon exceeding one year? Furthermore, the period for holding options to qualify for capital gains treatment is mentioned yet not introduced into the model.

Finally, the basic formulation of the model appears inconsistent as stated in the illustration. That is, if "a company wants to give X

dollars of additional compensation to a number of its executives but also wants to minimize the overall costs, considering the corporation and the employee as a team," changes in the mix of costs assumed by each party affect the net return to the executives. I suggest that the proposed change leaves the model in a state that is no more realistic than its predecessor.

ROGER M. EMANUEL  
*Concord, California*

*An improvement*

Mr. Emanuel comments correctly that consideration of flotation cost suggests that the opportunity cost to the company of stock options is less than formulated under the original model. However, contrary to his conclusion that the revision is trivial, I believe the introduction of flotation costs and recognition of the need to estimate market values are significant because this alters the compensation indifference point and thus substantially changes data which management may utilize in deciding whether to offer executives options or increased salary.

The illustration included in the article compared the simple model with a model incorporating flotation costs and market values, and it found that the indifference point was substantially lower using the revised model. Instead of \$100,000, the compensation indifference point

was \$52,000 or \$64,000 depending upon the estimated market value of the company's stock when the option is exercised.

Although the illustration was inserted only to indicate how the model might be used, it appears that a substantial decrease in the indifference point is likely when flotation costs are considered. This decrease justifies offering stock options at lower salary levels than many writers have mentioned in the past. Management should recognize that the simple formulation of salary versus option decision is not adequate and, indeed, may be seriously misleading.

The example assumed a one-year holding period because this is a common requirement of option plans now in effect. It should be remembered that the opportunity cost of options involves only the period between the date of grant and the exercise of an option. Under the 1964 Revenue Act this period may not exceed five years, and this is the relevant period for management's purposes.

Mr. Emanuel has erroneously referred to the three-year holding period for options and implies the model should include this factor. There is no holding period for options to qualify for capital gains. Rather, there is a three-year holding period for stock purchased under exercise of stock options. After an option is exercised and

stock is purchased, such stock must be held three years prior to disposal in order to qualify for capital gains treatment.

Aside from considerations of the time value of money concept discussed later, introduction of the three-year holding period for stock into the model is totally irrelevant and would render the model worthless. I want to emphasize that the relevant period for management's purposes is the holding period for options, which often is one year and which may not exceed five years.

Most mathematical models in business and economics are simplifications of reality; basically they are an attempt to isolate a few factors and to analyze interrelationships among the variables under examination. The revised model I have introduced obviously is a simplification of the complex option versus salary decision problem, but I believe it represents an improvement over the simple model. It is an attempt to concentrate upon several essential features of the two forms of compensation, salary and stock options. However, a reader should realize the model is only one tool among many which management would utilize in making stock option decisions.

Numerous factors were ignored in order to focus upon the indifference point as one criterion management can employ in its selection of executives to whom options may be offered. Mr. Emanuel mentions the time value of money and discounted cash flows. Possibly the more important omissions should

have been stated in the article. However, the purpose of the revised model was to recognize the influence of flotation costs on the simple model. I agree that inclusion of the time value of money, discounted cash flows, and several other factors would be desirable, but then the formula might have become so unwieldy that its value and utility for management would have been decreased.

Finally, Mr. Emanuel has stated that changes in the mix of costs assumed by each party affect the net return to the executives. This is not correct because one of the basic conditions of the model is that the net return to the executives remains the same under either the salary or option alternative (see page 25 of the March-April issue).

In conclusion, I would like to point out an error in the printing of the article. The final formula for the original model was incorrectly printed (on page 25) as follows:

$$T_p + 1 - (1 - T_g)(1 - T_c)$$

It should read as follows:

$$T_p = 1 - (1 - T_g)(1 - T_c).$$

*Linda H. Kistler*

*Lowell Technological Institute  
Lowell, Massachusetts*

#### **First IMPACT**

As former executive vice president of the Computer Dynamics Corporation (now part of Bunker Ramo Corporation), I developed and used a proprietary planning and control technique called IMPACT for government and industry clients in 1962.

This system incorporated many of the features of the one described in the article on page 34 of the July-August, 1967, issue ("Systems Approach to Integrating Cost and Technical Data" by Howard M. Carlisle). The Computer Dynamics IMPACT system was recognized by IBM as preceding theirs and the Air Force IMPACT system as well as portions of the concepts being copyrighted.

Since MANAGEMENT SERVICES is copyrighted and uses the term "IMPACT," there should perhaps be some recognition given to the original IMPACT, which also has been published.

**B. J. HANSEN**  
*Vice President*

*John I. Thompson & Company  
Washington, D.C.*

#### **More information?**

I was surprised to receive [a copy of] the letter from Mr. B. J. Hansen of John I. Thompson & Company regarding his prior development of a similar technique utilizing the title of IMPACT. I was never aware of such a system. I would like very much to have access to information [about his technique] since I am in the process of writing a book . . . regarding planning and control techniques of this nature.

I would like to apologize for not [referring to Mr. Hansen's system], but, as you can see, I was entirely unaware of it.

**HOWARD M. CARLISLE**, *Head  
Department of Business  
Administration,  
Utah State University,  
Logan, Utah*

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**Bertram A. Colbert • Pathway to Profit: The Management Information System . . . . . p. 15**

What is a management information system? Should every company have one? How can it get one? This article attempts to answer these questions—first by

defining the management process and the part information plays in it and then by sketching a general framework for analysis of data needs.

**Robert K. Zimmer • On Line-Real Time Systems for Customer Service Operations . . . . . p. 25**

Utilities and other companies with large field staffs for customer service find this group difficult to supervise effectively because of the communications problems inherent in the nature of the work. This author

outlines a computer system that has greatly improved the scheduling and control of servicemen's activities in a large gas utility that is now using it in a modified form.

**Matthew C. Fox • Safety Stock: Key to Effective Inventory Management . . . . . p. 33**

Despite widely hailed, and fairly widespread, advances in inventory management, many companies still make the mistake of confusing the problem of safety stock with the problem of lead time. When

they run short of stock, they step up order quantities rather than order frequencies, with consequences that are spelled out here. The solution, says the author, is simple—more attention to patterns of demand.

**William C. House • Use of Sensitivity Analysis in Capital Budgeting . . . . . p. 37**

The decision whether or not to invest in a capital project depends heavily on the estimated rate of return, which in turn depends on forecasts of sales, prices, costs, and the like. Like all forecasts, any or all of these may prove inaccurate. Although manage-

ment cannot avoid forecasting errors, it can hedge against them by determining which will have a significant effect on the rate of return. The technique to be used, explained in this article, is that of sensitivity analysis.

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SEPTEMBER-OCTOBER, 1967

# MANAGEMENT SERVICES

*a magazine of planning, systems, and controls*

**William T. Kelley • Advertising Control: A Computer Application . . . . . p. 41**

As in other areas where there are large masses of data to monitor, the control of advertising expenditures is a natural field for computerization. This

author describes a system that provides current budget control, cost data, accounts payable control, audit reports, and various statistical analyses.

**David F. Linowes • The CPA's Role in Mergers . . . . . p. 49**

While a merger is under consideration, values have to be established; after the arrangement has been made final, administrative procedures and personnel need to be integrated. During both periods the CPA

is in a position to provide important services, ranging from helping to measure the acquisition's usefulness as part of a combined operation to redesigning the organization chart.

**Edward J. Mock • The Investment of Corporate Cash . . . . . p. 53**

Cash is no longer allowed to lie idle in corporate coffers, and the ability to invest it profitably has become an important qualification of financial managers. Safety of principal, liquidity, length of maturity

of securities, and yield must all be balanced in the short-term investment program, and this article offers a mathematical pointing system for achieving those four ends.

## DEPARTMENTS

**People, events, techniques . . . . . p. 7**

**What people are writing about . . . . . p. 58**

Current books and magazine articles on subjects of interest to management and management consultants.

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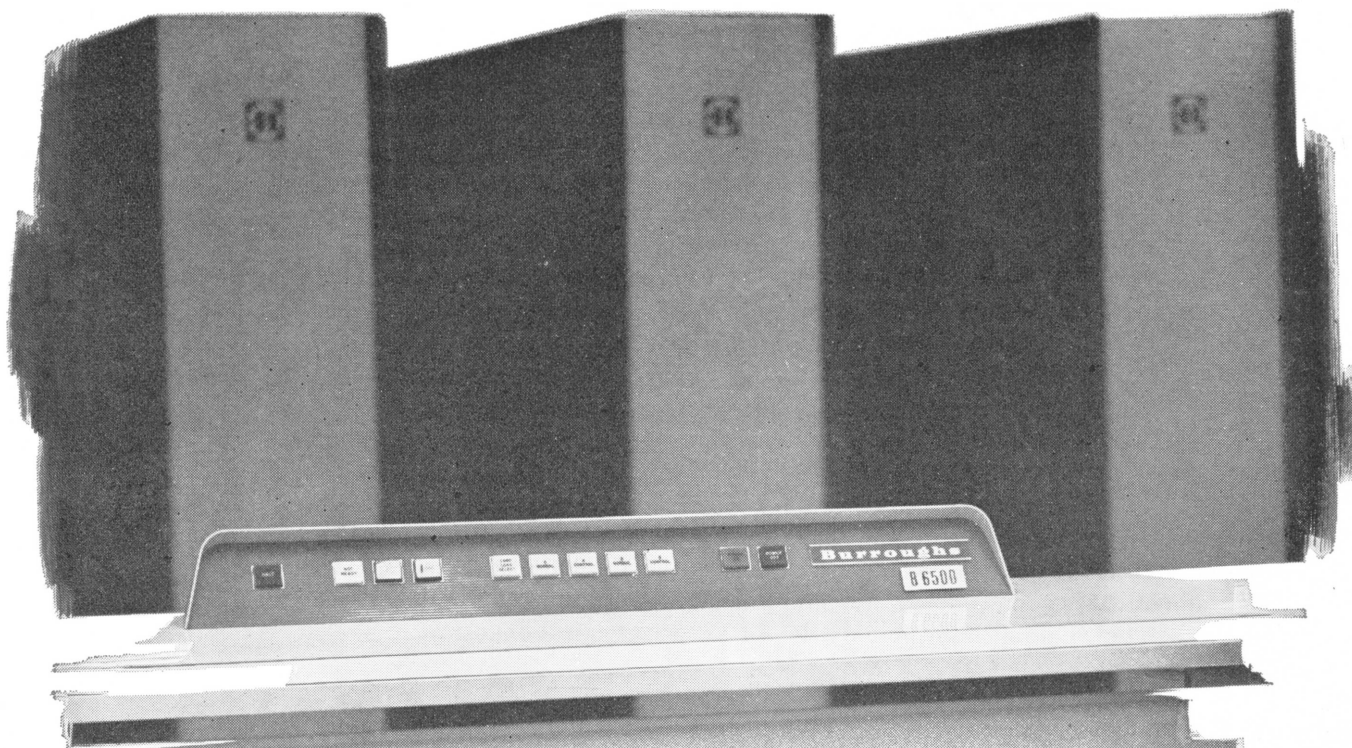
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NOW, THERE'S THE NEW BURROUGHS B 6500. With advanced third generation hardware. With the industry's only fully proven operating system—the Burroughs Master Control Program. With multipro-

cessing as its standard operating mode.

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It has everything needed for multiprocessor, on-line, time sharing, and real-time operations.

This logical evolution means that B 5500 users have a direct route to

even higher capacity and performance. At minimum cost. Because their current programs will run with full efficiency on the B 6500.

It means that users of other large systems need not face revolution again when they've changed over to the B 6500. And we can even help make that changeover a gentle one. Watch this magazine next month when we will tell you about the next logical step in the Burroughs data processing evolution.

**Burroughs**   
DETROIT, MICHIGAN 48232

## people, events, techniques

### American Bankers Association Maps Four Steps to Achieve Checkless Society; Chicago Reveals Troubles With Fraud

A number of steps that promise to move the "checkless society" from the area of mere speculation up onto the drawing board are currently being planned by a committee of the American Bankers Association.

W. Putman Livingston, chairman of ABA's checkless society committee, who earlier referred to checklessness as "one of the truly significant promises of the computer age," said that his committee is planning a scrupulous testing of the various alternatives that might be implemented as checkless payment mechanisms. (See news story, *M/S*, July-August, '67, p. 6.)

"Our purpose," Livingston said, "is to review present payment mechanisms in the light of today's developments to determine whether the computer and related devices have the potential of creating an additional payment system with sufficient advantages to be tested for possible implementation. So far, the evidence indicates a real need

for alternative ways of handling payments."

Livingston enumerated the following steps being planned by his committee:

- A meeting in the near future with representatives of the retailing industry (whose check volume is the largest of any single U.S. industry) to establish a closer working relationship between retail sectors and banking and to discuss mutual interests

- Meetings with major equipment manufacturers to study the design needs for terminal devices that will be compatible with the computer equipment of the banking and retailing industries and other possible users of the cashless system

- Selection of suitable sites for checkless society pilot projects, preferably community areas that are conducive to controlled studies of automated payments

- A bankers' workshop to study preauthorized payment plans, prob-

ably to be held in spring, 1968.

Preauthorized payment, one method of turning some of the writing and processing of checks over to machines, is an arrangement whereby a bank, acting on a customer's authorization, receives and pays certain recurring bills, such as those for electricity or insurance premiums. Funds are electronically transferred from the customer's account directly to the biller's, either internally or from bank to bank.

#### *Check volume rising*

U.S. banks are currently handling 17 billion checks a year, Livingston said, and this volume is increasing at a rate of six to seven per cent a year. A type of automated payment, similar to the system that is already coming into general use in Great Britain under the name of "standing orders," could reduce substantially the U.S. banking industry's serious burden of check paper.

## **Manufacturer cautions bankers: new banking systems must be designed for new computers**

However, the real test of the workability and practical advantages of alternative methods of implementing the checkless society and the types of equipment to be used will come from the committee's pilot projects, Livingston pointed out. "Ideally, we should have a number of dry runs in pilot communities as initial steps in moving from the theoretical to the practical state. We want this kind of laboratory results as part of our evidence before we begin talking about wholesale applications," he concluded.

ABA may be working toward making electronic money and credit transfer a reality, but at least one computer manufacturer has cautioned bankers to defer plans for a cashless society until computer systems have been made sophisticated enough to handle the basic banking functions.

### **Honeywell sounds caution**

At a recent computer seminar for bankers held in New York City, Benjamin W. Taunton, banking and finance industry manager for Honeywell's electronic data processing division, told his audience that instead of trying to modify older systems for use on a third-generation computer, banks should be concerned with setting up a basic banking system on these newer computers.

Pressure has been put on computer manufacturers to develop highly specialized computer applications associated with credit cards and other cashless society functions, Taunton said, but these manufacturers have a long way to go to meet the requirements for effective on line-real time banking systems.

Not enough banks have organized their files enough to move ahead functionally with their computer systems, Taunton said, and attempts to computerize customer

service jobs before systems have been adapted to handle fundamental banking needs "might create problems and delay development of an effective data processing system."

## **Chicago Reports Heavy Fraud in Use of Bank Credit Cards**

Glowing predictions about the cashless, checkless society are causing some discomfort in Chicago, where a few powerful and usually sophisticated banks have been badly swindled in consumer credit card abuses.

The Harris Trust & Savings Bank, the Central National Bank, and the First National Bank of Chicago have all been forced to revoke cards they issued last fall, according to *Business Week*. They are issuing new ones, but only to carefully screened credit risks.

Other Chicago area banks, while not calling in their old cards, are policing their operations far more carefully and will let cards for poor risks lapse when the expiration date is reached.

Origin of the whole situation came late last year when Chicago banks, in a tight competitive situation, covered their entire area with bank credit cards — 5,000,000 of them as a matter of fact.

They did this late enough in the year to run into the notorious Christmas mailing jam at the Chicago post office. As a result, cards addressed to names picked up from mailing lists often did not reach their original destination. Cards disappeared in the post office, en route, or from mail boxes in apartment houses.

Complaisant merchants, who did not check credit card holders' identification carefully as long as purchases did not exceed \$50, the

mark at which credit purchases had to be cleared with the bank (most fraudulent cardholders carefully kept purchases below the \$50 line) completed the circle.

Net loss to Chicago banks: an estimated 5 per cent on credit card operations compared to the average 1 per cent loss in such credit deals.

The banks, wiser but sadder and quite a bit less profitable, are not giving up their credit card scheme. But they have inaugurated 26 changes designed to discourage fraud. Among these:

A strict edict to some merchants, who now must clear every credit card purchase, no matter how small, with the bank

A check with the alleged purchaser, if it develops his card is being used several times a day in scattered locations

Sending out all new cards by registered mail, to ensure that they really reach the persons to whom they're addressed.

## **Air Force Cancels IBM Contract Following Manufacturers' Protests**

A General Accounting Office investigation of an Air Force contract with IBM for \$114 million of computer systems has caused the Air Force to cancel the contract.

Instigating the GAO investigation were protests that IBM's bid for the Air Force contract was \$60 million to \$70 million higher than those of the other bidders, Honeywell, Burroughs Corp., and RCA. (See news story, *M/S*, July-August, '67, p. 6.)

The Air Force claimed that IBM was chosen because that manufacturer best met Air Force requirements.

However, Comptroller General Elmer B. Staats ruled that the Air Force should have offered IBM's

rival bidders an opportunity to meet Air Force specifications. September-October 1967 (whole issue)

So now the Air Force has admitted that perhaps it made a mistake in selecting IBM for the contract and says it will reopen negotiations with the four computer manufacturers.

### **Navy gives new contract**

Another less publicized armed forces contract has been awarded to Computer Sciences Corporation to perform analytical and design studies aimed at increasing the capabilities of the computer-based combat data systems of the U.S. Navy's Fleet Computer Programming Center.

The Center supports the Naval Tactical Data System which enables the Navy's aircraft and ships to detect and intercept hostile forces.

Under the new contract, which is expected to exceed \$1 million over a three-year period, Computer Sciences will supply the Fleet Computer Programming Center with the following services:

- Analysis, design, and evaluation of the functional areas of the Naval Tactical Data System, such as communication, tracking, and interceptor control
- Evaluation of program production requirements for planned and existing computer complexes in both shore and shipboard use

Requirements analyses and recommendations for current and future computer languages, processors, and operating systems that will help the Navy fully utilize its EDP systems.

### **Banks Sued Again for Offering Outside Services**

Two more suits have been launched against banks for providing services considered not within the proper scope of banking.

The Association of Data Processing Service Organizations filed suit in mid-June to prevent banks' offering electronic data processing

services, in the September-October issue of the *New York Post*, August 3; a month later a number of travel agents filed suit in Federal Court requesting that banks be forbidden to act as travel agents.

These suits followed litigation, still pending, filed against the Comptroller of the Currency charging that the Comptroller exceeded his authority by allowing national banks to sponsor their own mutual funds.

The insurance industry is also understood to be concerned over what it regards as bank intrusion into its business.

A bill was introduced in the last session of Congress to prohibit banks from offering accounting services to their customers. It died in committee, but it has been re-

introduced this year by Rep. Abraham Multer (Dem., N.Y.).

Rep. Wright Patman (Dem., Texas), chairman of the House Banking Committee, commenting on the rising number of complaints against banks, said:

"Banks are getting out of the banking business. They are going into competition with their own customers."

Patman hoped to get hearings started in August to determine whether legislation is needed to curb banking activities in non-banking fields.

He cited mortgage brokerage and servicing, direct lease financing, and estate counseling as other areas where banks were engaging in services "not really in their field."

## **Higher Compensation Still Most Reliable Sales Incentive, NICB Report Says**

The National Industrial Conference Board has finally discovered the most powerful incentive for urging salesmen to sell more. More money.

The recently released report, based on the views of 16 senior executives from a cross-section of industry, concludes beyond a shadow of a doubt that cash incentives are the easiest, most logical, and most effective means of motivating salesmen.

The participating executives did agree, though, that incentive programs really should appeal to more than the salesman's desire for money, such as his competitive spirit and his need for individual recognition, advancement and promotion, and job satisfaction.

A majority of the executives also agreed that noncash incentives, such as sales contests with winners receiving expense-paid trips or expensive merchandise, represent an important psychological motivation.

It was noted, however, that these noncash incentives should be made in addition to the regular incentive—more money.

In the same vein as the NICB discovery, an Everett, Massachusetts, company has found the answer to the growing business concern about college students who think that industry offers no challenge: "Offer the man 50 per cent of everything he sells."

The 83-year-old company, Chesterton Packing & Seal Company, which designs and manufactures mechanical packing and mechanical seals for pumps and other hydraulic equipment, found it difficult to staff its distributors with competent sales/marketing personnel.

So the company decided to help its distributors out by launching an intensive training program for recruits. Chesterton pays for the program, plus paying each man a salary until he is placed with a distributor. But the big attraction to the college graduate is that after he is placed, he is guaranteed 50 per cent of the gross sales profit.

As pointed out by the company's president, Richard T. McDermott, all involved stand to benefit immeasurably—manufacturer, distributor, and salesman.

## Four Carolina Hospitals Set Up Electronic Communications Network in Two States for Business and Medical Use

Four hospitals in North and South Carolina will participate in an electronic communications network through which information will flow between a central computer center and TV-like display units located at the hospitals' nursing stations, doctors' consultation areas, service departments, and business offices.

The four have formed a new company, Medi-Data Inc., in Charlotte, N.C., to handle operations.

### Service will start in '68

Hospitals participating in the computer service, which will become effective July 1, 1968, include Charlotte Memorial Hospital, Presbyterian Hospital, and Mercy Hospital in Charlotte and Greenville Hospital System in Greenville, S.C.

Medi-Data has signed a \$12,000,000 contract with Burroughs Corporation for two time-sharing B5500 computer systems and over 200 input and display units. The remote devices in the hospitals for sending and receiving information will be connected to the computer center via telephone communication lines.

John Rankin, president of Medi-Data and director of Charlotte Memorial Hospital, said that a six-month feasibility study by a hospital consulting firm indicates that nurses spend up to 50 per cent of their time doing paperwork rather than giving patient care at the bedside. And Medicare has further increased the reporting requirements of hospitals.

### Will speed diagnoses

The new computerized communications system, Rankin said, should speed up diagnosis by 12 to 24 hours, reduce the average patient's stay in the hospital by as much as one day, relieve nurses and others of overburdening cler-



Nurse can request from computers at Charlotte, N.C., any needed information on patient through input-output unit at her nursing station.

ical work, and help reduce hospital costs, which have been increasing at a rate of ten per cent a year, cumulatively.

"By reducing the average length of stay by 12½ per cent," Rankin pointed out, "the size of the hospital effectively increases by 12½ per cent. This potential reflects a tremendous saving in cost of hospital construction and added staff requirements."

### Four advantages cited

Among the major advantages to result from the electronic on line computer system, Rankin named the following:

- Inaccuracies caused by many transcriptions of data from document to document will be eliminated.

- Each hospital participating in the system will have access to identical medical chart information and standard diagnoses, which will create a standard environment for physicians.

- Prior to bedside visits, each physician will receive a listing of

his patients in the hospital and the current medical status of each for his review.

The input and display devices in doctors' offices or at the hospital can be tied to the system for medical record information entry and retrieval, enabling the doctor to keep tabs on the status of critical patients.

- Each hospital department's work will be scheduled hourly and daily by the computer, using information entered from doctors' orders to prepare work schedules for nursing stations, operating rooms, and other facilities and personnel. And the computer will also send a reminder notice if the work is not performed in the prescribed time.

### West Coast hospital plans EDP

Franklin Hospital in San Francisco has hired Lockheed Missiles & Space Co., Sunnyside, California, to install a computerized business office service to process the hospital's paperwork.

The first portion of the projected three-phase service to be activated will be patient billing and accounts receivable. A complete medical order communications system and a totally integrated computerized system may follow.

Under the business office service phase, Lockheed will install equipment in the hospital to translate business data into machine-readable form and then will feed the data into a large computer at the company's Sunnyvale headquarters. Franklin will then receive regular analyses and reports on which the hospital's officials may act.

For instance, raw data entered into the computer system, such as payroll information, will return to the hospital as checks and earnings statements, W-2 forms, man-hour

budget reports, employee time records, and other documents. The Lockheed billing service will also produce a daily hospital "census," weekly accounts receivable statements, detailed bills, and regular revenue reports.

According to Lockheed project manager Ivan H. Corner, Jr.: "Much of the need for this service arises from the increase in state and federal health care programs. A great deal of paperwork is required of hospitals participating in programs such as Medi-Cal and Medicare."

Changing to the computerized system represents a major step toward general expansion and modernization of the 250-bed community hospital's operations. A new facility will replace Franklin's present plant on the same site this fall, and a 130-bed extended care facility is expected to be completed by 1969.

### **Lockheed gets federal contract**

Lockheed also has a new federal study contract with the U.S. Public Health Service to analyze the reporting requirements and data problems of 27 representative hospitals around the country, it was announced.

The \$40,000 contract is explained by Corner, again serving as project director, as the result of a growing need among hospitals for a streamlined way to produce reports on their daily operations. "The number of reports a hospital must produce is mushrooming," Corner said. "Reports are needed by state and federal agencies that provide medical care funds, by local and regional planning boards, by research organizations, and so on."

In trying to make this task easier, LMSC's job will be to plan and recommend two alternative information collection systems that could be used by any hospital in the nation—one system for manual tabulation and the other for mechanical or electronic data processing. (See "Solution to Medicare Accounting Problems," M/S, July-Aug. '67, p. 28.)

## **Airlines Plan Common**

### **Reservation System**

### **For Travel Agents**

An extension of the on line reservation system, which many major airlines now have for their own ticket agents, to travel agents and travel departments of business firms is now planned for next year.

There will be one major difference between the new computer reservation system and those already in use by individual lines. The scheme planned for travel agencies and business transportation personnel is based on a computer system which would be shared by most domestic carriers. Thus travel agents and business offices would need only one input-output unit, linked to two computers based in Chicago. These computers would carry flight information covering all domestic operations of the 22 airlines initially sharing the system.

Extra added attractions are promised travel agents. Their output units will also show on display screens a typical hotel room in the establishment the customer plans to use, the special attractions of a given resort area, and even car rental information from the area.

The plan, announced by TWA, is expected to be in operation by the fall of 1968, but in the meantime American Airlines, pioneer of automated reservations, says it will tie in 87 travel agents and business travel units to its own Sabre system by September of this year. American does, however, plan to join the common system when it is operating next year.

### **American may have forced issue**

However, background suggests that American actually forced the hand of the other carriers when it announced in early August that it planned to install its own machines, tied to its own computer, at travel agents' offices. Other major airlines, such as TWA, Eastern and United, lacking a system as

elaborate as American's, may have rushed the announcement of the common system following American's announcement of its own scheme.

And American is careful to note that its agreement to join in the common reservation plan is not a legal commitment.

"It isn't binding," according to an American spokesman. "It merely says we are interested in an automated common system when and if someone comes up with something."

The common system was developed by the Reuben H. Donnelly Corporation of Chicago, publisher of the Official Airline Guide for schedules and tariffs.

Cost of the service, based on 2500 subscribing agents, is estimated at \$15 million for the computer installation, \$5 million for programming, and \$2.5 million annual operating costs.



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cruise is aimed at a better understanding of the circulation of the eastern tropical Pacific waters and their biological populations.



IBM 1800 unit is hoisted aboard "Thomas Washington"

#### *Four main jobs*

Specifically, the IBM 1800 has four main jobs to perform on board ship, as listed by E. H. Coughran, research staff member of IBM's Los Angeles Scientific Center:

1. Performing the regular routine logging of the marine environment, including measuring water depth, checking sea-surface temperatures and salinity (every five minutes if necessary), calculating wind speed and direction, and automatically taking air temperature and humidity measurements.

2. Collecting data for specific scientific experiments, such as calculating the biologically important properties from automatic measuring instruments.

3. Working toward a more accurate knowledge of a ship's position at sea, providing better knowledge of the origin of the data it is collecting. Next year, as satellite navigation becomes available, the computer will be able to calculate the ship's position very accurately every 90 minutes as the satellite swings overhead and to replot the ship's course if necessary.

4. Providing the scientist with a general-purpose computer with which to analyze previously unanticipated relationships from the reduced data—so that the scientist will be able to write completely new analysis programs or modify old ones while still at sea.

Although the IBM 1800 data acquisition and control system is already being used to control complex scientific processes such as glass production, oil refining, drug research, and air-pollution testing, Coughran said, this marks its first installation aboard a research ship. "It is capable of functioning over a wide range of temperature and humidity conditions," he added, "and will be able to withstand the ship's pitching, rolling, and yawing motions."

## Seagoing Computer Will Aid Marine Research By Giving Instantaneous Solution to Problems

An IBM 1800 will soon go on active duty aboard a Scripps Institution of Oceanography research vessel, the "Thomas Washington."

As part of a joint research project being conducted by Scripps and IBM, the computer will allow Scripps scientists to collect and immediately act on information obtained from the sea without having to wait for a return to port and processing by computers there.

According to Dr. William A. Nierenberg, director of the University of California, San Diego's Scripps Institution of Oceanography, "scientists at sea would prefer to have immediate analyses of their research while the ship is still in its area of operation in order

to confirm their findings before moving on to a new work station." Also, use of the computer could allow a chief scientist to decide whether to alter course midway in an expedition.

Initially, the IBM 1800 will be used in short research trips through Southern California waters so that Scripps and IBM technicians can study the equipment and its applications under cruise conditions.

A later 55-day cruise in eastern tropical Pacific waters began August 1. This research cruise is part of the Eastropac Expedition that began last January. Sponsored by the U.S. Bureau of Commercial Fisheries and funded mainly by the Office of Naval Research, the



## “It’s good business to help colleges”

“Our colleges and universities must have enormous quantities of new money almost constantly if they are to be enabled to serve society as it needs to be served. Every business institution benefits today from the money and labors that those now dead have put into the building of these institutions. We are all dependent upon them for future numbers of educated young men and women from which to choose, and for the continued expansion of man’s knowledge of the world he inhabits.

“We owe these institutions a great debt, and we can pay this debt in two ways: By supporting them generously with contributions of money and time, and by upholding their freedom to remain places of open discussion, and to pursue truth wherever it is to be found.

“Last year our company contributed to colleges and universities more than \$310,000 which represented 1.2% of profit before tax.”

**J. Irwin Miller, Chairman  
Cummins Engine Company**

A major problem in the education of students is rising costs. If companies wish to insure the availability of college talent, they must help support colleges with financial aid.



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## “It’s good business to help colleges”

“Business has a direct and pressing need for colleges of high calibre. Carnation recognizes that its success tomorrow depends in large part upon the quality of the college graduates it hires today. We also benefit from the continuing stream of ideas and information which college researchers provide.

“Colleges are faced by the continuing pressure of higher costs due in large part to the demands of a more complex technology. To maintain their standards and to fulfill their crucial role, they need increased support by business.

“Carnation now provides voluntary financial aid to more than 125 colleges and feels that this is one of its best investments for the future.”

**H. E. Olson, President  
Carnation Company**

A major problem in the education of students is rising costs. If companies wish to insure the availability of college talent, they must help support colleges with financial aid.

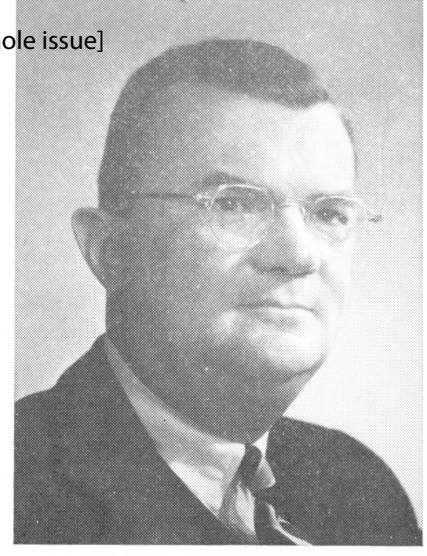


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## “It’s good business to help colleges”

“The greatness of America stems importantly from our many fine educational institutions, and industry is critically dependent on their graduates.

“The du Pont Company hires a large number of college graduates each year. As these employees gain business knowledge and experience, they supply tomorrow’s need for managers and leaders of our Company.

“In 1966 we will grant \$2,200,000 to 213 colleges and universities in all parts of the nation to help them educate leaders of the future. This represents the largest grant in the 48-year history of the du Pont Company’s Aid-to-Education program.”

**Lamot du Pont Copeland, President,  
E. I. du Pont de Nemours & Co. (Inc.)**

A major problem in the education of students is rising costs. If companies wish to insure the availability of college talent, they must help support colleges with financial aid.



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# THE SKILLED LABOR SHORTAGE IS A MYTH.

As long as hundreds of thousands of unskilled American workers are unemployed, any talk of a skilled labor "shortage" is 100% nonsense.

You say typists are in short supply? How long does it take to train somebody to become a good typist? About two months. In two months, the shortage of typists could disappear. (Of course, many of the new typists might be from some minority group or other, but would that really matter?)

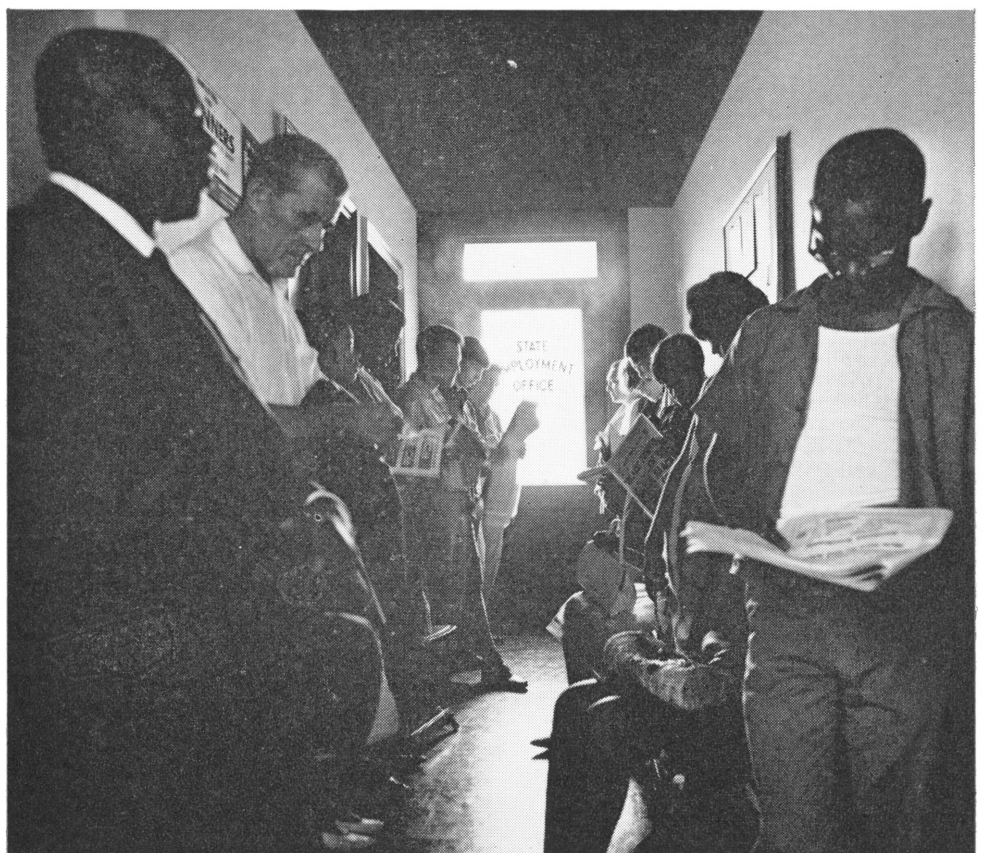
No welders around? Four months of crash training is all it would take to hatch a new, skilled batch.

Draftsmen, machinists, welders, assemblers, molders—the story is the same. A few months' training could work wonders.

Times are changing. Since World War II, thousands of new products and hundreds of new industries have appeared.

Yet during this time, there has been a systematic neglect of training for skilled trades. Doesn't make sense, does it?

(The companies in best shape today are those that sponsored training for unskilled workers during the non-shortage years. Score one for good old American horse sense!)



Things are changing, too. If you think it's still a buyer's market in labor you're due for a couple of rude shocks.

And if you still "don't like" to hire minority workers—for whatever reason—you'll learn that your business survival may well depend on these same minorities.

Many of America's top corporations are already spending millions to train people, including Negroes and other minorities, for skilled jobs.

350 of these corporations have formed a voluntary organization called Plans for Progress. They are working hard to spread the word about equal job opportunity and how to make it work for everybody. If you would like more information, write: Plans for Progress, 1800 G Street N.W., Washington, D. C. 20006.

Training the unskilled has many advantages; there are no disadvantages.

If you hear of one, it's a myth.

Things are changing.



*A company's information system should not be merely an internal mechanism for direction and control. Ideally, it should aid the company's response to all external events that could affect it, as well —*

## **PATHWAY TO PROFIT: THE MANAGEMENT INFORMATION SYSTEM**

*by Bertram A. Colbert*

*Price Waterhouse & Co.*

**W**HAT HAS information to do with profitability? Every chief executive knows it has a great deal to do with it. Information plays a major, usually a crucial, role in achieving profits—the profits which are one of the main indexes of successful business operations in our economy.

Obviously, the manager must understand and evaluate a wide range of information about his operations in order to reach sound, profitable decisions. Concise, complete, and timely management information thus forms the basis for effective planning, decision making, and control.

As the complexity and magnitude of business decisions have increased, the typical corporate manager has found that existing systems do not have the capability to deliver the significant data required at the time they are required. Too often the manager has found himself overwhelmed with masses of data or long listings of historical information which were of little help in the decision making and planning processes.

The need for a better way was clearly evident. Therefore, many companies, both large and small, are seeking ways to improve their information and data flow and its

end use—the generation of profit. The result has been the group of techniques called the management information system.

Let us consider some basic questions:

What is a management information system? How does it differ from such existing systems as accounting, sales, or production? Should you have one? What is its value? How do you obtain one or put one in a specific company?

This article attempts to answer these questions, to show graphically the management process and the part information plays in it, and finally to provide a frame of ref-

**External information is needed to assure that management is aware of outside events . . .**

erence within which each executive, by further analysis, can obtain more complete specific answers, tailored to his company's needs.

We may begin by noting the functions of management: to plan, to organize, to direct, and to control, as indicated in Chart 1 on page 17, and by illustrating the role which information plays in this process (Chart 2 on page 17). Information which is internal is necessary to provide communication in the management process. Information which is external is necessary to assure that management is aware of, first, the outside events which may influence the plan and, second, the effect of the operation on this outside world. As information is received, we may recycle through the management process: RE-plan, RE-organize, RE-direct, with the measurement in the control process.

To provide a framework for discussion, let us consider the organization of a typical company (Chart 3 on page 18). The company has five principal functions: administration, marketing, research and development, manufacturing, and finance. The relationship to the board of directors and the specific departments which we might find in each function are depicted in Chart 3.

**Management information system**

A management information system, simply, is an organized method of providing each manager with all the data and only those data which he needs for decision, when he needs them, and in a form which aids his understanding and stimulates his action.

Such a system

1. Considers the full effect of a decision in advance by supplying complete, accurate, and timely data for use in the planning and decision making processes

2. Eliminates from the planning and decision making processes the problems associated with the use of inconsistent and incomplete data by providing a means for preparing and presenting information in a uniform manner

3. Uses common data and methods in the preparation of long-range and short-term plans

4. Identifies, structures, and quantifies significant past relationships and forecasts future relationships through the use of advanced mathematical techniques in analyzing data

5. Merges financial and production data to produce significant measures of performance to facilitate control of present costs and to facilitate planning decisions with minimum processing of data

6. Recognizes the needs of all corporate units so that the requirements of each are met with a minimum of duplication while serving the corporation as a whole

7. Reduces the time and volume of information required to make decisions by reporting to each level of management only necessary degrees of detail and usually only the exception from the standard or norm

8. Utilizes personnel and data processing equipment effectively so that the optimum in speed and accuracy is achieved at the lowest cost

9. Requires that the data be presented to those responsible for

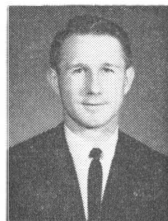
the decision making and planning processes in a form which minimizes the need for analysis and interpretation

10. Provides flexibility and adaptability to change.

The concept of management information is one that would be equally valid if the company were small or large or if the data were obtained and processed through the most simple manual means or through the most sophisticated computer. Management must, to design a system, select at each level of control only the data that are required. The data must be presented in a manner which facilitates understanding and action and provides a measure of the effectiveness of the action which has been and is being taken.

Most growing companies and many mature companies show certain symptoms or clear indications of what we can call "information hunger." Some of these symptoms may, of course, arise simply from poor management, even when the information system is adequate, but we have listed them here because they are so common and often so baffling even to competent managers. Many managers just do not realize that the information on which they are basing even their most routine decisions may be dangerously inadequate or misleading because their information system is not geared to the needs of their company. Let us turn to Chart 4 on page 18 and consider the 25 symptoms any or any combination of which may indicate an inadequate information system.

In the operational aspect of the business, they range from large inventory adjustments to a sterile R&D program; in the human aspect, from inability to note the significance of certain financial indicators to overloaded briefcases and poring over reports at midnight.



**BERTRAM A. COLBERT** is a principal in the Chicago office of Price Waterhouse & Co. In the past he has held positions as production engineer, production manager, and wage and salary administrator in the electronics

and metal manufacturing industries. Mr. Colbert is a member of the American Institute of Industrial Engineers and the American Management Association.

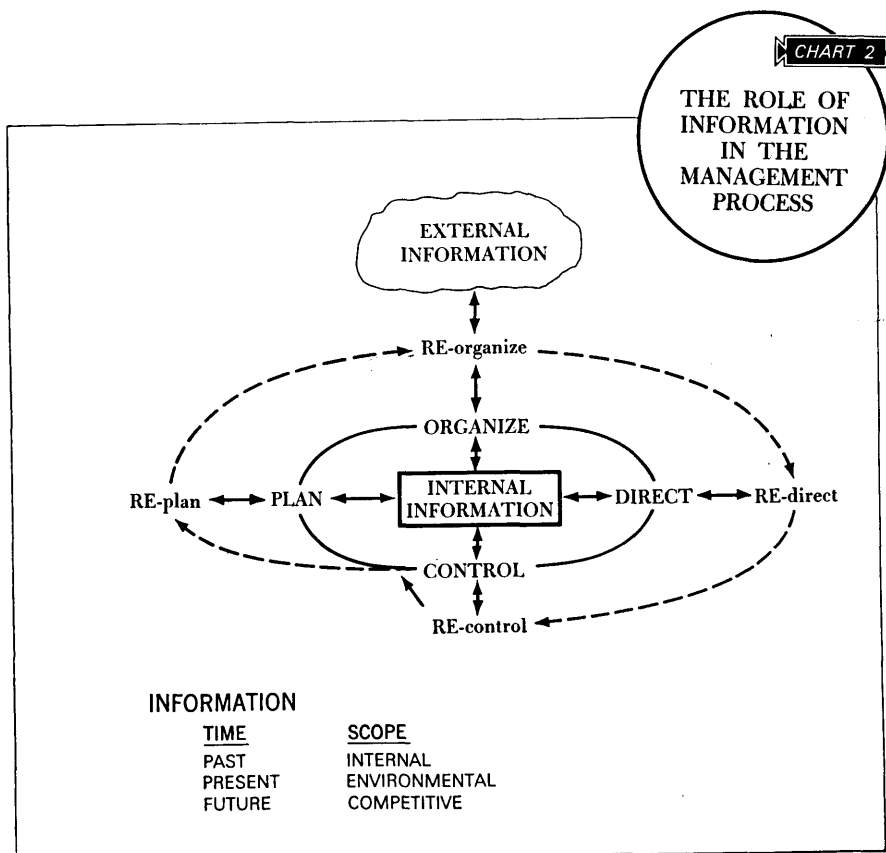
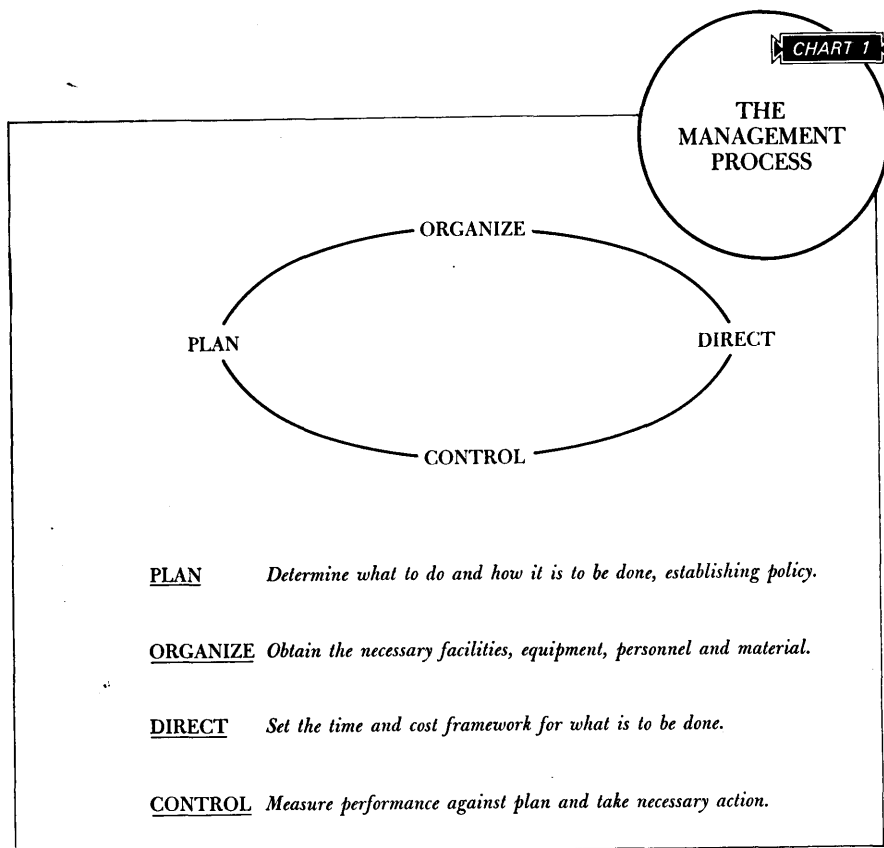
... which may influence the plan and the operation's effect on the outside world.

Any executive will do well to study these symptoms and note whether his organization exhibits one or more of them. A study of the present scope of management information in the typical enterprise (as shown in Chart 5 on page 18) and a comparison of the typical management informational efforts with the values to be received through each (shown in Chart 6 on page 18) show that in the typical organization management is either using its information facilities too narrowly or has not developed facilities of the necessary scope and significance to ensure the enterprise's future. As indicated, most managements devote 90 per cent of their efforts to obtaining information which will enable them to operate and control and only about 5 per cent of their efforts to obtaining the necessary information to meet competition and another 5 per cent to obtaining the information needed to meet future needs. These proportions do not make the organization adaptable to change and may lead to such stagnation or such poor preparation that a competitor's new product or a change in consumers' tastes and needs may knock the enterprise right out of the ball game.

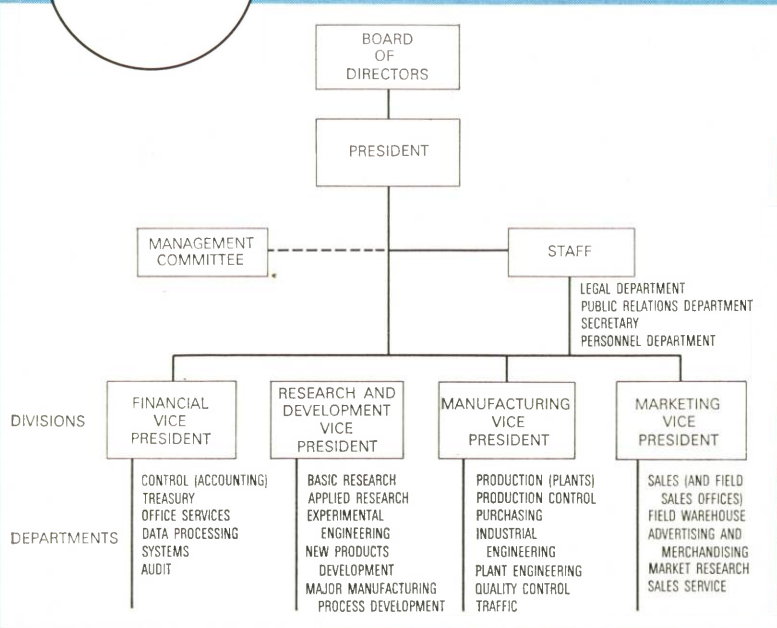
**Kinds of information needed**

What, then, are the kinds of information which managers need? They can be grouped into three major categories: information which various company executives require for operation and control, information required to assess future action, and information required to assess or compare performance by the company in competition or within the industry.

Let us look first at information required for management operation and control. A great deal has been written on this subject, and most organizations of any size or



ORGANIZATION OF A TYPICAL COMPANY



OPERATIONAL	PSYCHOLOGICAL	REPORT CONTENT
Large physical inventory adjustments	Surprise at financial results	Excessive use of tabulations of figures
Capital expenditure overruns	Poor attitude of executives about usefulness of information	Multiple preparation and distribution of identical data
Inability of executives to explain changes from year to year in operating results	Lack of understanding of financial information on part of nonfinancial executives	Disagreeing information from different sources
Uncertain direction of company growth	Lack of concern for environmental changes	Lack of periodic comparative information and trends
Cost variances unexplainable	Executive homework reviewing reports considered excessive	Lateness of information
No order backlog awareness		Too little or excess detail
No internal discussion of reported data		Inaccurate information
Insufficient knowledge about competition		Lack of standards for comparison
Purchasing parts from outside vendors when internal capability and capacity to make is available		Failure to identify variances by cause and responsibility
Record of some "sour" investments in facilities, or in programs, such as R & D and advertising		Inadequate externally generated information

CHART 4

SYMPTOMS OF AN INADEQUATE MANAGEMENT INFORMATION SYSTEM

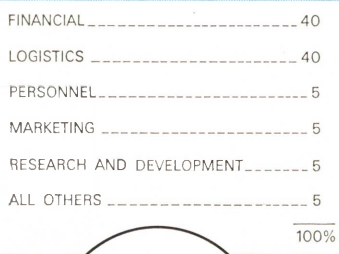
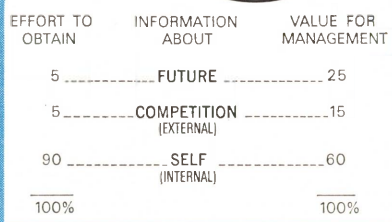


CHART 6

TYPICAL MANAGEMENT INFORMATION EFFORTS VERSUS MANAGEMENT INFORMATION NEEDS



PRESENT SCOPE OF MANAGEMENT INFORMATION

CHART 5

MANAGEMENT INFORMATION SYSTEMS MAJOR INFORMATIONAL REQUIREMENTS

FINANCIAL	
Cash and working capital positions, forecasts, analyses	Sources and availability of capital
Current ratios	Short-term requirements
Line of credit utilization	Money market developments
Temporary investment opportunities	Stock
Accounts receivable turnover, age, collection status, problem accounts	—ownership changes
Inventory investment analysis	—prices and P/E trends
Debt to equity status	—analyst opinions
Adequacy of reserves	Lease obligations
Analysis of surplus	Financial guarantees and other contingent obligations
Long-term spending requirements	Adequacy of insurance coverage
—R & D	Tax situation
—new products	Internal accounting control situation
—capital assets	

RESEARCH AND DEVELOPMENT

- Knowledge of research discoveries and advances in existing knowledge
- Research opportunities
- Research goals and balance of effort
- Research proposal evaluation
  - product improvements
  - new products
  - new materials
  - process improvements
- Research projects
  - status—technically
  - status—cost
- Research personnel
  - qualifications
  - experience
- Scientist support
- Research space/person
- Research cost as % of sales
- Historical evidence of value of research to company

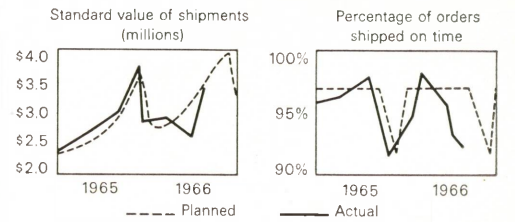
CHART 9

MANAGEMENT INFORMATION SYSTEMS MAJOR INFORMATIONAL REQUIREMENTS

PERIODIC MANUFACTURING REPORT PERFORMANCE HIGHLIGHTS

Shipments increased as expected this month. However, Herron Manufacturing Co., one of our principal motor suppliers, was on strike until four weeks ago. Accordingly, we were not able to build inventory as planned in preparation for the added shipments. As a result, we had to go to a partial third shift for the assembly department and add a number of new employees throughout the plants this month. The inexperience of the new employees and the lack of adequate supervision on the partial third shift led to decreased delivery performance and labor productivity, particularly in the machining department. These problems have been largely corrected and we expect improved performance next month.

KEY INFORMATION



YEAR TO DATE EXPENDITURES (millions)	ACTUAL AS PERCENTAGE OF		
	Actual	Plan	Last year
Operating—controllable	\$15.61	102%	122%
Operating—uncontrollable	\$ 5.95	101%	109%
Capital	\$ 1.10	104%	81%
% OF TOOLS PASSED INSPECTION			
Month	97.6%	98%	99%
To date	99.4%	99%	100%
% OF LABOR PRODUCTIVITY			
Month	91.5%	93%	94%
To date	98.1%	101%	103%
INVENTORY TURNOVER	3.9 times	98%	100%

EXAMPLE OF A KEY ITEM MANAGEMENT INFORMATION SYSTEMS REPORT

CHART 7

sophistication have developed fairly good and reliable information-generating systems for operations (production, inventory, efficiency). Where they often fall down is in the selection, organization, and processing of this information. The best method of employing such information is that of rigid selection by need—that is, sending key information to executives, information processed purely for the management requirements as indicated and requested by the recipients. A system called *Key Item Control* (described in *MANAGEMENT SERVICES*, January-February, '67, p. 21) gives a detailed discussion of such a method.

Control, of course, is obtained by comparing actual performance for each given activity with pre-established goals set at each level. The principal value of presenting key items to management using exception techniques is that it focuses management attention on the important areas of operation which require action. A typical operating report of this type (Chart 7 on page 18) shows how the tabular information normally presented in a company could be re-presented to enhance understanding and provide data for decision. This is done through a blending of narrative, graphic, and tabular techniques of presenting information. The overall highlights of the operations are given in a narrative summary. Graphs present comparisons of present performance with planned performance in the framework of trends to provide current perspective, and tables provide key figures of detail information.

Let us now suggest the kinds of information which should be generated in two key areas, financial and research and development (Chart 8 on page 18 and Chart 9 on page 18). Some 23 items are suggested in the financial area in Chart 8, and 15 in the R&D area in Chart 9. It can be seen that the data vary widely from an analysis of sources and availability of capital in the financial area to a research personnel analysis in the

R&D segment. Nevertheless, top management must consider all the kinds of information its operations require and then turn to the task of processing this information to achieve maximum use from it.

The financial information available to management is usually quite complete. Often, however, the accounting data are not as integrated with operating control information as would be practical or desirable. Frequently the chart of accounts provides information for audit, internal control, or tax purposes but not specifically for management control. Often major improvement would result from integrating operating management information with cost management information. In this approach, the source documents used to provide information for operating statistical purposes would provide cost and financial management information as direct products.

### *Techniques of improvement*

Substantial improvement in most companies' management information would result from the following:

1. Increased use of ratios to provide improved understanding of the effects or results of operations, including graphic presentations of the ratios to provide analysis of both short-term and long-range trends. The data would also provide an improved basis for forecasting probable future events, particularly in the cost area.

2. Use of information developed from using work sampling, work measurement, and work simplification techniques. This would provide improved measures of the effectiveness of personnel in the clerical and production groups. In addition, these techniques would permit costs of specific operations to be determined and would enable management to determine the most efficient and least costly way to perform them. A further benefit of using such techniques would be the development of cost data which would be integrated with operat-

ing statistical data and thus improve management information.

3. Increased use of network techniques of presentation. Specifically, this would place in focus all of the events that would be involved in a particular management activity and would define their relationship to each other. This technique could be of great value in determining the chain of events which must take place in order to implement a management decision which was made on the basis of improved management information. It would also provide understanding of the time and personnel which would be involved in such an implementation.

4. Increased use of PERT techniques in the cost system. The PERT technique places cost information in relation to the event occurrence. This approach would incorporate the principles of flexible budgeting.

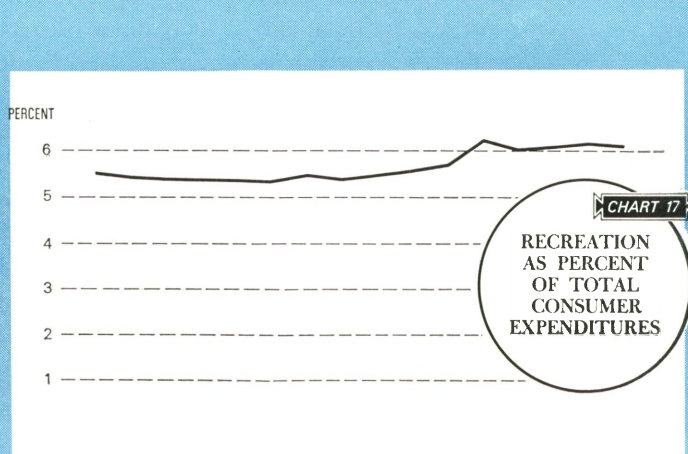
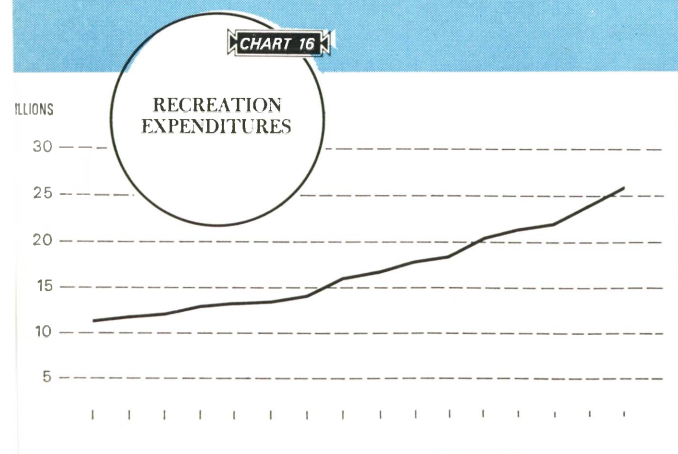
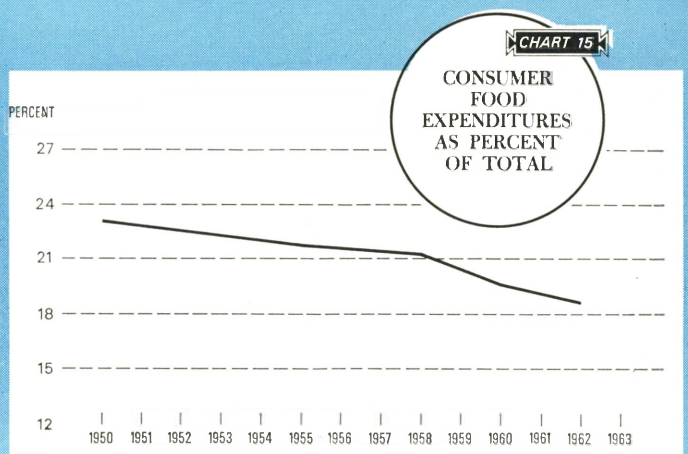
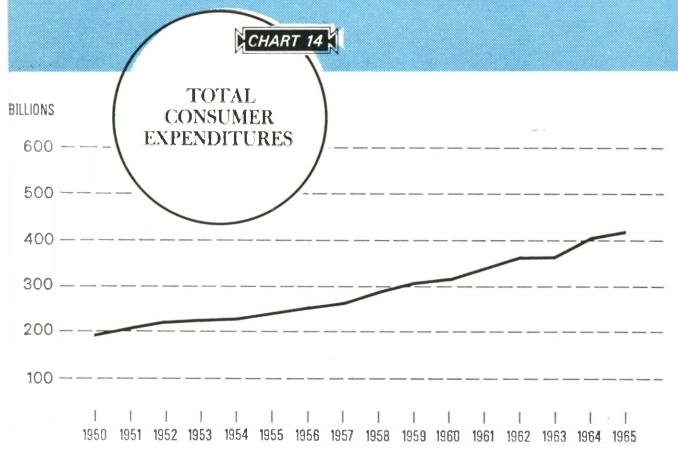
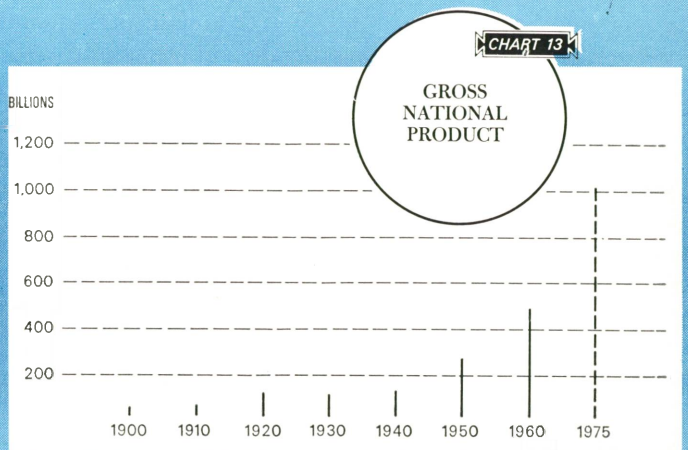
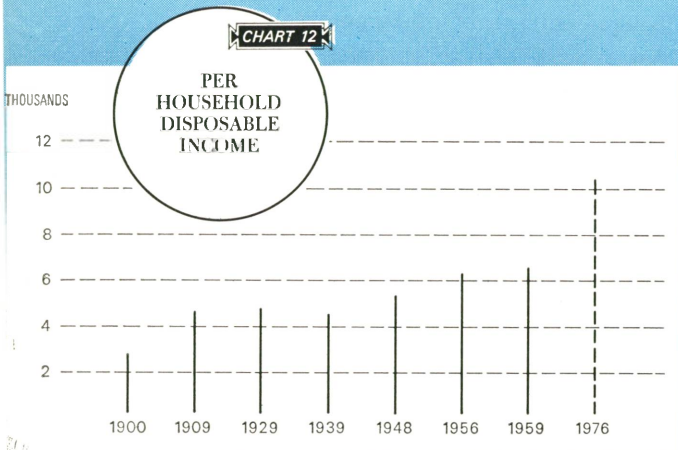
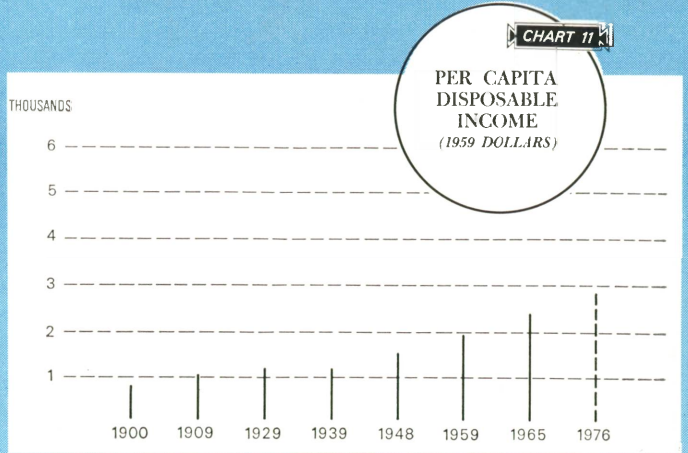
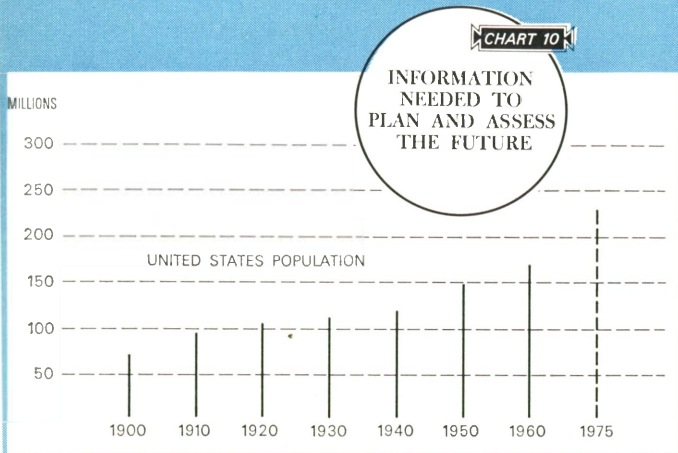
5. Increased use of incremental cost concepts. These would improve the decision making related to costs of operating facilities at various production levels. This cost concept would provide management with an improved tool for determining the cost effect of operating a given facility at different specific levels or volumes of production by measuring the cost effect in major steps or increments rather than only by an average slope or trend.

6. Increased use of data processing equipment as the means of securing vital data in a timely and effective manner to implement the new concepts involved.

7. Increased attention to the development of a stimulating incentive which would serve as a motivation to management to take action on the basis of the information provided by an improved management information and control system.

### *Range of information*

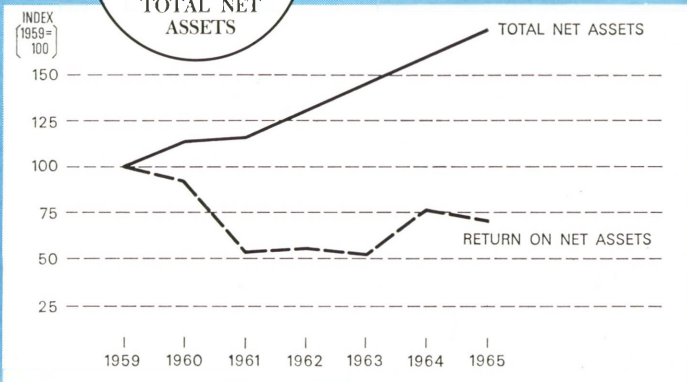
Each chief executive represents a different company of different size in a different location. To a large extent, his problems are individual. He does, however, oper-



THIRD CATEGORY OF INFORMATION

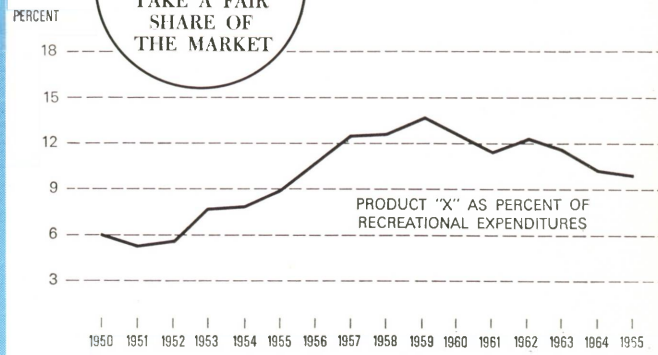
"X" INDUSTRY TOTAL NET ASSETS COMPARED TO RETURN ON TOTAL NET ASSETS

CHART 19



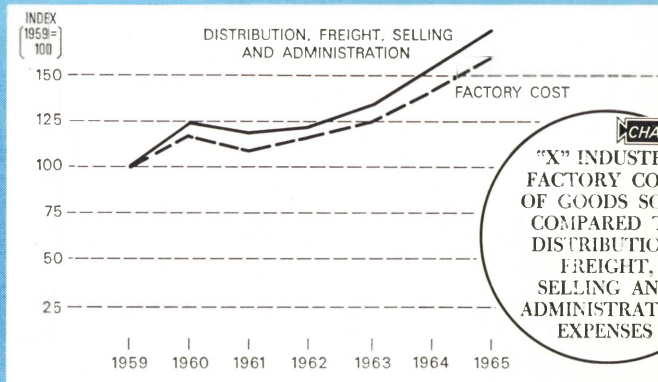
INFORMATION NEEDED TO COMPETE AND TAKE A FAIR SHARE OF THE MARKET

CHART 18



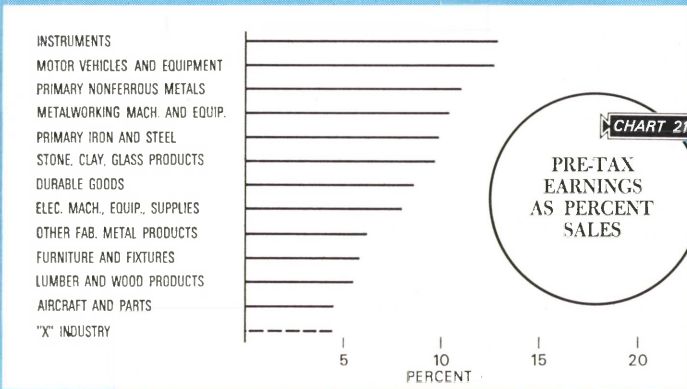
"X" INDUSTRY FACTORY COST OF GOODS SO COMPARED TO DISTRIBUTION, FREIGHT, SELLING AND ADMINISTRATIVE EXPENSES

CHART 20



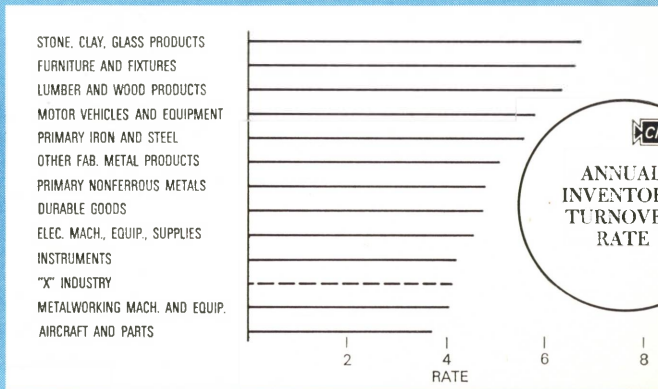
PRE-TAX EARNINGS AS PERCENT SALES

CHART 21



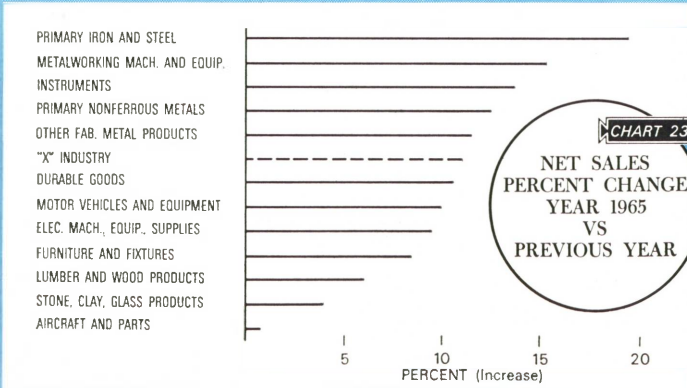
ANNUAL INVENTOR TURNOVER RATE

CHART 22



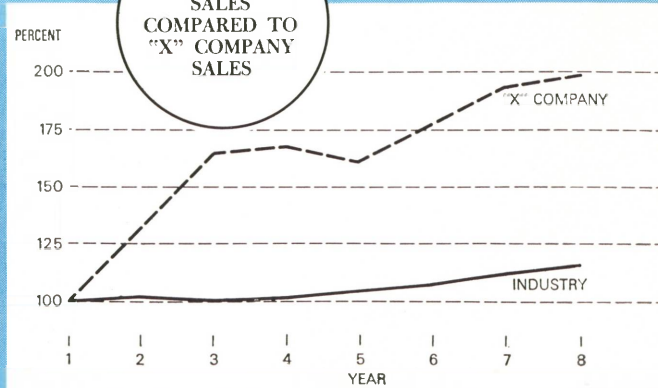
NET SALES PERCENT CHANGE YEAR 1965 VS PREVIOUS YEAR

CHART 23



INDUSTRY SALES COMPARED TO "X" COMPANY SALES

CHART 24





ate within the framework of a certain industry and can make decisions based on analyses of the data in a specific industry.

To illustrate the range of information which might be significant to the management of a typical company, let us now turn to a study of information of the second category: information required to assess future action. For our purposes let us call our illustrative company Company X (although they do not make the well known "Brand X"). This company markets a product in the consumer industry and is affected by consumer patterns of spending. What kind of information would management review to plan and assess future action? Let us consider the following data:

**Population growth effect**

First, management might look at the effect of growth in population (Chart 10 on page 20). In 1910 the population of the United States was about 90 million people. The population now is close to 200 million; the population has doubled in less than the lifetime of most managers. As you can see from the projection for 1975, population is expected to increase another 30 per cent to 40 per cent in this shorter time. We are in an era of rapidly changing, rapidly increasing population.

This growing population has very interesting characteristics for our Company X. Perhaps the most significant is shown in Chart 11 on page 20. This is a measure, since 1900, of per capita disposable personal income. Income for the individual has gone from less than \$1,000 per person in 1900 to almost \$3,000 per person and is rising at an increasing rate; it is expected to approach \$4,000 by 1980. Such predictions have often proved to be conservative. We have a rising population which is living better.

Now Company X management might consider the effect of this increase in per capita income and the additional increase in the working population as reflected in

per household disposable income (Chart 12 on page 20). As noted, this income has gone from \$4,000 to \$6,000 per household since 1939 and is expected to exceed \$10,000 in ten years. Gross national product, which has nearly tripled since 1950, is likely to pass the \$1,000-billion mark by 1975 (Chart 13 on page 20). Next, management of Company X can note that, in the period since 1950, our total of consumer expenditures in the United States has gone from \$200 billion to \$400 billion (Chart 14 on page 20). The population in this period has not doubled, but our per capita income has just about doubled.

What does this mean for Company X? It means people have much more money to spend individually and, therefore, in total. One of the most interesting things is that, with this income, expenditures have become more discretionary. People have more money, but they have begun spending it in different ways even in the short span of ten to fifteen years. Chart 15 on page 20 indicates that in 1950 our population was spending almost 23 per cent of its total income for food. By 1962 this had dropped to 19 per cent. This growing population which has more money is spending it increasingly in areas other than for food — spending it for clothing, shelter, transportation; for moving to suburban areas of larger homes where people have an average of almost two cars per family; spending it on increased recreation—on better living.

**Recreation expenditures**

Perhaps the most significant characteristic of the economy for the industry in which Company X operates is shown in Chart 16 on page 20, which charts the expenditures on recreation. This chart indicates that these expenditures have increased from about 12 billion to 27 billion dollars, more than doubling in the past 15 years.

As Chart 17 on page 20 indicates, in this period the consumer ex-

*We now come to that third category of information—the information needed to compete in an industry and to obtain a fair share of the market.*

CHART 25

RATIO OF NET PROFITS ON SALES  
(INDUSTRY-  
"X" COMPANY)

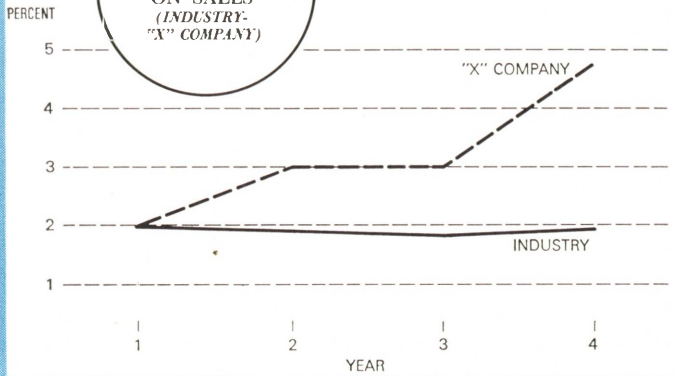


CHART 27

RATIO OF CURRENT ASSETS TO CURRENT LIABILITIES

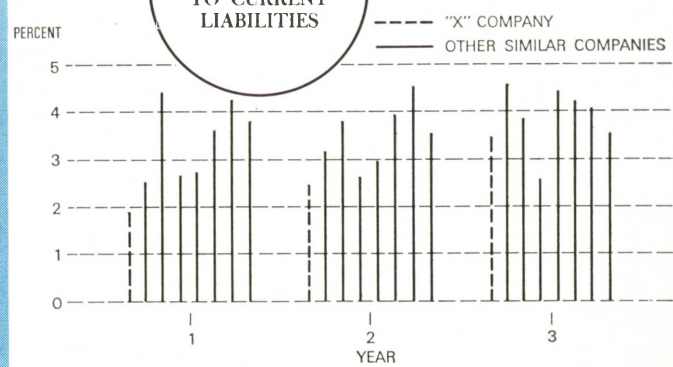


CHART 26

RATIO OF NET PROFIT TO INVESTED CAPITAL  
(INDUSTRY-  
"X" COMPANY)

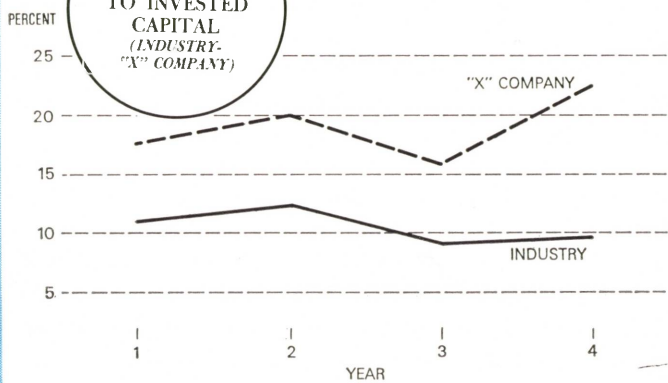
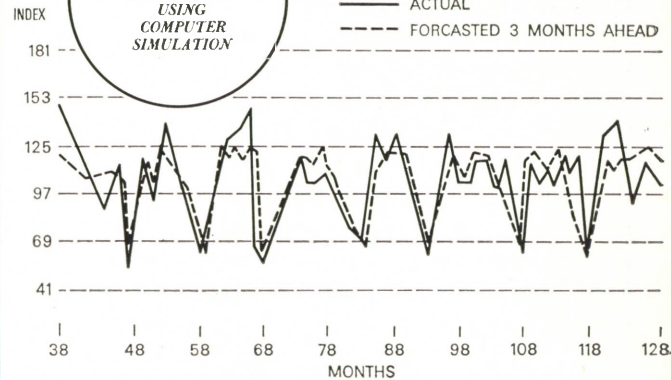


CHART 28

PRICE INDEX  
(1/53-6/63)  
FORECASTED USING  
COMPUTER  
SIMULATION



penditures on recreation as a per cent of total expenditures have risen from 5 per cent to over 6 per cent as a result of the shift in consumer interests.

We now come to that third category of information—the information needed to compete in an industry and to obtain a fair share of the market. Here we present some of the kinds of information in this category and show how the managers of our Company X might use it to place themselves in the industry.

We can start with some calculations for Product X made by our company showing the expenditures for Product X as a per cent of total recreational expenditures (Chart 18 on page 21). This ratio indi-

cates that, while there was a rise from the 1950 to 1959 period, there has been a downward trend in the past six years, with a reduction from 12 per cent to 9 per cent, or almost a 25 per cent change in the ratio. For planning purposes in this industry, this should be a significant area of concern.

One of the measures of profitability of a company is that of return on net assets. It reflects the return on this portion of the investment in the company. As shown on Chart 19 on page 21, the return from the period of 1959 to just recently has definitely gone down about 30 per cent in a period where the net assets themselves were rising over 50 per cent. This indicates weakness in cost control,

a key requirement in remaining competitive.

Another measure which might well affect competitive position is the change in cost of goods sold as compared to selling, distribution, and administrative expenses (Chart 20 on page 21). This analysis indicates a significant increase exceeding 50 per cent for the period, with the trend increasing for the overhead costs in relation to factory costs. This indicates a need for review of manpower utilization and distribution cost controls.

A third measure might be the pre-tax earnings as a per cent of sales for the "X" industry compared to twelve major industries for the past year (Chart 21 on page 21). The chart indicates that in relative

ranking, the "X" industry has the lowest per cent of earnings.

Fourth, management might look at the annual inventory turnover rate for the same group of industries (Chart 22 on page 21). The desirability of management action to improve its cash position as indicated by this measure of performance is clear.

Next let us observe the measure of sales change from 1964 to 1965 (Chart 23 on page 21). The chart indicates that "X" industry is average as compared to the group.

### *Moving out ahead*

Up to now we have been speaking generally about industry averages. Perhaps the most significant item noticed in Company X's relationship with companies in its industry is the effect of individual management ability and action. One can go along with the crowd. A company can become profitable as its industry becomes profitable, or it can lose money as the industry loses money if it acts only as the average company does. There have been dramatic instances which show that when management of a specific company takes dynamic, aggressive action, it can (despite what has happened on the average to the industry in general) make its company more profitable than average. It can use the information in an improved management information system for management action.

Let us then consider the case of Company X as an instance of this kind of action. To protect the identity of our illustrative company, we will not identify specific years or the specific industry.

Let us look, however, at this actual industry and Company X. Chart 24 on page 21 shows industry average sales for a recent eight-year period compared with sales for Company X. The industry sales increased through the period as shown in previous charts, rising 20 per cent in the eight-year period. The sales of Company X doubled in the same period as a result of

the policy that it had adopted. Turning to the ratio of net profits on sales for a recent four-year period in Chart 25 on page 23, we note that industry profit on sales has stayed generally about 2 per cent, declining slightly as shown in earlier charts. Profit on sales for Company X, however, rose from 2 per cent to almost 5 per cent in the same period as a result of the individual actions which management in that company had taken.

In the ratio of net profit to invested capital (Chart 26 on page 23), the industry in the recent four-year period has shown a rate of about 10 per cent and slightly decreasing. The profit picture of Company X is considerably more attractive than the industry average, increasing from 17 per cent to almost 25 per cent in the same period.

With regard to the ratio of current assets to current liabilities (Chart 27 on page 23) for a recent three-year period of Company X as compared with eight individual companies representative generally of companies in the industry, the ratio of assets to liabilities for the companies in the industry has changed very little, while in the three-year period Company X has rapidly increased its ratio to a more and more attractive figure.

These charts show clearly the effect when individual management takes action, based on information available through its information system—when a company does not merely follow the trends in the industry, but makes its own trend. There are many factors to consider in improving profits. By itself, no system, no data processing installation, no plant modernization can do the whole job. Each must, to be effective, operate within the framework of good management, and good management always and everywhere depends on good information.

The manager in industry operates in the present in influencing his profit picture. Knowledge of past and present operations, as shown in our charts, is one of his

basic tools. However, the manager must plan for the future to assure continuity of profits. To do this, he needs a good forecast of future demands on materials, labor, facilities, and capital, and good forecasting again requires good information.

In recent years, tools for prediction have been greatly improved. The use of mathematical techniques for quantifying and analyzing probability have provided important contributions to the management decision making process. Increasingly, the use of computers for rapid solution of mathematical "models" of business problems has provided a tool which can increase profitability of operations.

To illustrate, in Chart 28 on page 23 results are shown which were obtained from forecasting using a simulation technique recently developed by a Price Waterhouse & Co. mathematician, J. L. Ray. The solid line shows the actual price index for the 128-month period from 1953 to mid-1963. The dotted line shows the price index forecast by the model three months in advance of the actual month.

The computer program is designed so that, for example, at month 40, the computer reviews the predicted price index for month 40, the actual price index reported for month 40, the deviation from prediction for month 40, and the deviation pattern for each previous month of actual to forecast. The program then calculates the best prediction for month 43 based on all past history. This forecast simulator is a general purpose tool which has proven to be remarkably effective in a wide variety of predictions. It provides the manager of today a technique for improvement of his decision making.

In summary, the profit picture in any company in the future will be to a significant extent a result of the gathering and intelligent use of good information. Each company should be concerned that it is providing its managers with the kind and quality of information they need to do their job well.

*Getting the right man to the right place at the right time is in essence a scheduling problem. Here's the way one utility used an on line-real time system to improve service call procedures —*

## **ON LINE-REAL TIME SYSTEMS FOR CUSTOMER SERVICE OPERATIONS**

*by Robert K. Zimmer*

*University of Minnesota*

ONE OF the most difficult functions to manage in business is "in-the-field" customer service. A major problem is management's lack of direct supervision over the men providing the services. They work their eight hours with only infrequent communication with supervision. Because of the nature of the work, adequate control and effective direction of effort are difficult for small customer service operations—and almost impossible for large ones.

For proper scheduling and control company management should know at all times the progress the service force has made in the performance of assigned tasks, the estimated time needed to complete each type of service work, the serviceman most capable of filling each service request, the present

company work load, the time commitment for the work to be performed and for the distance to be traveled, and the estimated future demand for services.

The purpose of this article is to outline a computer system that will eliminate many of the major problems facing company management in the development of an effective control system for customer service. Although the general problem exists in all large in-the-field customer service operations, the approach that was used in solving the problem for a large public utility in the gas industry is the basis for this discussion.

### ***Utility customer service***

The customer service function of a large public utility constitutes

one of its major costs. It is often stated that these costs are also its least controllable. Many utilities have more than 500 servicemen operating in the field during a given day. Although the serviceman usually report periodically to a dispatch board, for the most part they are without first-line supervision during the work day. This is not caused by weak management but by the lack of an effective control tool.

The first step in developing a workable solution to the control of servicemen in the field was to determine the major problems in the customer service area. The second was to conduct a feasibility study to determine the economics of various alternative solutions to the problems.

Discussions with the customer

## The problem is to dispatch the right number of properly qualified . . .

service personnel indicated that the principal cause of lack of control over the serviceman in the field was the break in communication with the serviceman during the work day. The serviceman's whereabouts and the exact status of completed and partially completed work were not available on a timely basis.<sup>1</sup>

Depending on the characteristics of the individual company, within this major problem were a number of subproblems, including those of repeat orders, duplicate orders, travel patterns, overtime utilization, initial scheduling, special handling, classification, commitment, problem anticipation, and combination of service orders.

**Repeat orders**—Many times more than one service call is required to satisfy one particular need of a customer. Recognition of a second or additional requests for the same service is essential to control the quality of workmanship and to avoid costly delay in the execution of a request.

**Duplicate orders**—Sometimes a second request is made for service before the execution of the original order is attempted. An example is when the husband and

wife both telephone to have the range adjusted. In this case two servicemen may be dispatched to the customer's premises.

**Travel patterns**—The lack of knowledge of the work locations of the serviceman during the day, of the number of units of uncompleted work in his area, and of possible future service calls to be received reduces management's efficiency in scheduling servicemen. The travel pattern on any given day is likely to be a maze that results in excessive travel time and operating expense.

**Overtime utilization**—Because of the lack of up-to-date backlog data (including data on the type of work) and because of inability to forecast the next day's service load, many utilities require that all orders dispatched to the field should be executed the same day.<sup>2</sup> Naturally this causes wide fluctuation in daily service loads, creating overtime that otherwise might be avoided.

**Initial scheduling**—On the other hand, depending upon the company's service policy, up to 50 per cent of the service orders received one day are likely to be held for dispatch to the field on the following day. Thus, when the serviceman is sent into the field, he is allocated a certain number of service orders. The problem is to dispatch the right number of properly qualified servicemen to the areas of the city that will require their skills. This allocation depends upon the service request orders available in the morning and expectations about the next day's workload.

**Special handling**—Certain service

requests require the skills of a particular union-classified serviceman. An example is the large industrial clients of a utility. The problem is the recognition of the need for special handling and the ability to send the proper serviceman to execute the service.

**Classification**—Unionized servicemen are generally classified according to skills and seniority. These classifications limit the extent of service work that each one can perform.<sup>3</sup> Therefore, service request orders must be first classified by type of work and then distributed to men who are authorized to perform the service.

**Commitment**—A very costly problem facing a public utility—and most companies making deliveries—is the fact that the serviceman frequently cannot execute the work because no one is at home. Failure to get inside the premises means a return trip and possibly a complaint from the customer. The most prevalent cause is the failure to make a commitment to the customer for a reasonable expected time of arrival.

**Problem anticipation**—An abnormal build-up of certain service requests can be an indication of a major problem. Prompt recognition of this problem can give the company time to take corrective action. An example is when, within a relatively small section of the city, there is a sudden increase in gas leak complaints (many customers think they smell gas).

**Combination of service orders**—Certain types of work are of a routine nature. These include the removal of meters for testing and certain preventive services determined by the service policy of the utility. The problem is to recognize the existence of routine work at the

<sup>1</sup> The use of radios in all the service vehicles would theoretically make timely reporting to the dispatch board possible. Practically, it is not feasible because of the limited number of radio channels generally available and the large amount of data that must be transmitted to the dispatch center.



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<sup>2</sup> Although some categories of service work are of high priority and must be executed as soon as possible (gas leaks and no heat), most service requests could be executed the next day without inconvenience to the customer.

<sup>3</sup> For the purposes of illustration in this article, four classifications from most skilled to least skilled are assumed—Class I to Class IV.

... servicemen to those areas of the city that will require their skills.

time a service request order is to be dispatched to the serviceman. In this way the necessity of making a separate service call to accomplish the routine work can often be avoided.<sup>4</sup>

### System objectives

This analysis of the major problems facing the customer service function of a public utility makes it possible to define the objectives of a new system. These are as follows: assignment of the "right" serviceman; improvement of forecasting; gaining knowledge of the whereabouts of servicemen on a real-time basis; gaining access to the service orders for each serviceman, each grid, and each period of time (i.e., 90 days); reducing the nonproductive time of the servicemen; and integration of the entire customer service function.

The satisfaction of each objective depends upon the economics of any given utility. For the purposes of this article, it will be assumed that

<sup>4</sup> The combining of orders might be disadvantageous during the peak demand weeks. During these periods the routine work should be postponed.

economical justification can be made.<sup>5</sup>

*Assignment of "right" serviceman*—The system to be developed should assign the proper serviceman to the job. The assignment must take into consideration the present location of the serviceman, his classification, his work load in relation to the time the order is dispatched, and the commitment requirement of the service request.

*Improvement of forecasting*—Three levels of forecasting must be improved. First is the weekly forecast needed to determine the number of servicemen required daily to handle service requests. Some latitude exists here because the two days off per week per serviceman can often be changed, and other duties, including training sessions or, in some utilities, meter reading can be assigned with considerable flexibility.

Second is the forecasting of the next day's demand for service. This

<sup>5</sup> For large utilities (more than 700,000 customers), not only would there be a significant improvement in customer service but there would probably also be more than ample cost savings to justify the investment in the system.

forecast preferably should be by small sections of service area.

Third is the ability to recognize each day the miscalculations in the second level of forecasting. The ultimate objective here would be to forecast hourly throughout the day.

*Gaining knowledge of whereabouts of servicemen on a real time basis*—Not only for the purpose of scheduling but also for improved control over the serviceman, real-time knowledge of the whereabouts of the serviceman is one of the most important objectives of the new system. The objective would be to know within a specified confidence level where the serviceman is located at any given time.

*Gaining access to service orders for each serviceman, each grid, each period of time*—The ability to retrieve data about service orders is of primary importance. For previously executed orders it is important so that repeat orders can be recognized. For unexecuted orders, it is important to recognize duplicate orders, to determine which serviceman is working on a particular order, and to determine which orders are to be executed



Sometimes a second request for service is made before the execution of the original order is completed, as when both husband and wife telephone in to have the range adjusted.

within a certain grid (a defined subdivision of the city) Services: A Magazine of Planning, Systems and Controls, Vol. 4 (1967), No. 5, Art. 11

**Reducing nonproductive time of the serviceman**—Another objective of the new system is control of travel time and transportation costs to eliminate unnecessary repeat or duplicate service calls. This requires the development of standardized times to perform service at the customer's premises.<sup>7</sup>

**Integration of the entire customer service function**—To minimize duplication of effort, all of the customer's service history should be directly accessible. This means that the clerk taking the customer's telephone call should have access to all pertinent customer data, the servicemen's records, and, when required, the specific serviceman who is or will be handling any given service request for a given customer.

### **On line-real time system**

The development of the new system can best be explained in four segments. First, the development of an on-the-premises time-budgeting system will be described; second, an on line-real time retrieval system; third, a forecasting system; and fourth, the route and serviceman scheduling system. It should be kept in mind that these segments are not independent but are, in fact, quite interdependent.

**Time-budgeting system** — Most companies engaged in service operations have attempted to set standards for the time required to service the customer. For repairs on automobiles, for example, there are "flat-rate" manuals. For repairs on gas or electric appliances, however, where the repair time is on the customer's premises and where travel

time is required (including time to park the truck and walk to where the service work is needed), standardized rate books are more difficult to develop.

Nevertheless, standards development for service work is essentially the same as for any budgeting problem. One method is to utilize historical data on performance, adjusted according to what can be expected in the future. Another method is to utilize time study and similar measurements.

The development of travel standards is more complex. It is first necessary to know how far the serviceman will have to travel from one job to the next, taking into consideration times of the day and seasons of the year. Distances traveled can be determined by the use of a block coordinate system, which pinpoints the serviceman's last service call to within a block. The block coordinate system, which will be further explained in the discussion on scheduling, requires that blocks traveled be converted to miles traveled and that miles traveled then be converted to minutes traveled. In the latter calculation the time of day, the season of the year, and the location of the work become important.

For planning, the new system requires an estimated time to execute orders and an estimated completion time for each job. The use of historical standards and variances from normal appears to be the most logical source for these estimates and for travel time estimates as well. There are some obvious limitations to this approach, and the service company should expect to revise these standards after the new system becomes operational. Necessary data for revision of the standards, when required, can be found within the new system.

**Retrieval system**—Because of the large volume of data to be handled by a large utility or other service company it is usually necessary to think in terms of a third generation computer, one that has the necessary storage capabilities and an

on line-real time capability. Exactly which computer is required would depend on the input volume, storage, and analytical requirements for this system and on the overall computer needs of the company.

### **Data retrieval**

The ideal system would provide all customer service data on direct access files. Thus, when the customer called in for service, the service clerk could retrieve the data required by means of a display unit. For instance, if the customer requested a range adjustment, the clerk would type the customer's name and address and the request code into the visual display unit. From the computer the following data would be retrieved and shown on the display unit:

#### **A. At the time of the service request**

1. The duplicate service request would be recognized by a search of the customer's records. Each request would be coded on the customer's record when received.

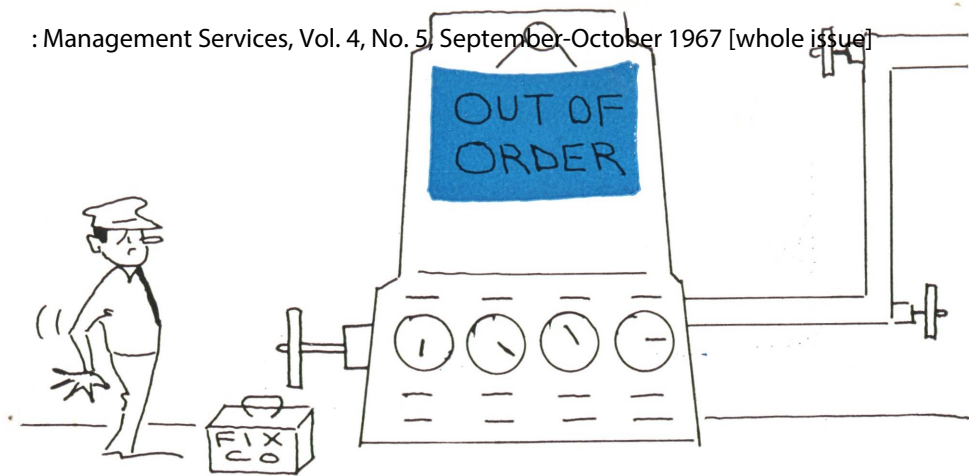
2. The repeat service request would be recognized by a search of the customer's records. All service requests would be recorded on tape for a period of 90 days. Each incoming service order executed would be matched against this tape. When the second order to be executed for the same work was received, the duplicate work would be noted on the customer's record. (In the test of the new system, it was found uneconomical to keep all service orders on direct access for the 90-day period.)

3. The special service requirements would be recognized by a search of the customer's records. Special service requirements (school, hospital, large manufacturing plant, etc.) would be flagged by the system.

4. The serviceman and commitment time for the order would be determined by a series of subroutines. The data to be ana-

<sup>6</sup> The grid is a specified part of the service area. Many cities have been developed in one-square-mile grids.

<sup>7</sup> The use of predetermined standards for each classification of service work is being employed successfully by a few utilities. Nevertheless, the deviations in the standards that are possible in normal situations make the system extremely difficult to operate effectively.



Certain requests—for example, those from large industrial clients of a utility—cause problems because they require the skills of a particular union-classified serviceman.

lyzed would include the following:

- a. location of each serviceman
- b. work load assigned to each serviceman
- c. standard times for each service request
- d. block coordinate for each customer
- e. formula to determine miles between each coordinate
- f. priority of each service request
- g. status of each order dispatched or in process of dispatching
- h. all routine work (routine meter removals).

#### B. *At the time of dispatch*

1. The service work assigned to each serviceman would be shown to the dispatcher.
2. The standard work that should be completed based on the dispatch time would be shown.
3. A list of the new orders to be dispatched to a particular serviceman would be displayed, including the following:
  - a. identification for future reference to the order
  - b. address of the customer
  - c. service request
  - d. estimated time of arrival
  - e. classification of work
  - f. comments (repeat order, duplicate, special handling, etc.).

A by-product of this system would be the availability of “account inquiry” information. The clerk taking the customer’s call would also have the following customer information immediately available:

- a. the last period’s consumption
- b. the current accounts receivable balance
- c. the last payment received
- d. the current month’s consumption
- e. the credit status
- f. the amount owed on appliance purchases
- g. the gas meter number and date set
- h. the classification of the customer

The visual display unit could be utilized not only to receive information from the computer but also to place information into it. If on-line capabilities were not necessary at the time of input, a scannable device would probably prove advantageous.<sup>8</sup> Batches of information might be placed into the computer every two or even six hours by means of a scannable document. The use of the scannable device would thus free other input

<sup>8</sup> The scanner is an input device that can translate pencil marks on a special document to digits usable by the computer.

devices for data that must be entered immediately.

Depending upon the service policy, the proportion of service calls that must be executed on the same day varies among utilities. Possibly future orders could be printed by the computer and assigned automatically to servicemen for future work days. The assignments would probably be made to loads designated by certain classifications and not to specific servicemen. Because of sickness, etc., the exact serviceman available could not be anticipated, at least in the case of the utility studied.

#### ***Variance reports***

The retrieval system also could be used to compare actual service call times with standard times and to print out management variance reports. The computer could store data about the service order at the time of request, but the execution data either could be placed into the computer at the time the serviceman called in for additional work or it could be placed by the use of a scannable document used in the field.

The scannable document would contain the identification number of the service request, the serviceman’s load number, and the date. The last two items would become a batch identification card. Thus, the scannable document should contain the following data: identifi-



cation number; service request code; date; work executed (coded); number of units of work required; traveling work units required; and supplies used to execute the work.

Once filled out, the scannable service order document, with a header card containing the employee's number and the truck number, date, and work shift, would be submitted to the foreman. These cards would be scanned and matched with the data stored in the computer. The management reports on variance could be issued as frequently as daily by serviceman, by foreman responsibility center, by service district, by entire work force, or by request category.

The tie-in to the on line-real time system would be advantageous for a number of reasons. First, the amount of information required on the scannable document would be reduced substantially. Second, the accuracy and speed of reports would be increased.

The timely reporting of variances in both travel and job execution should create in management a feeling of control, of confidence that it knows where the servicemen are and what they are doing. The knowledge thus gained could be used to evaluate and improve the performance of the servicemen. Variances from standard might indicate a need for additional serviceman training.

*Forecasting system*—For an effective scheduling and control system, it is necessary to forecast future demand accurately. At the lowest level one might use the previous day's demand to estimate the next day's demand. Or demand might be forecast by the use of historical records of demand in relation to degree days and to various climatological data. But there are other forecasting methods that are more scientific and sophisticated.

One relatively scientific approach is the use of multiple correlation analysis. The technique involves the correlating of demand (preferably by categories) to various independent variables that have a logical cause-effect relationship

with demand. Two examples are as follows:

Dependent Variable	Independent Variable
Gas leaks	per cent of odor in lines wind speed degree days yesterday's gas leaks leak demand for the last hour
No Gas Heat <sup>9</sup>	degree days yesterday's demand day of week humidity

The independent variables must be data that are readily available and can be used in the computer. This might require direct input of data by another department. For instance, the percentage of odor in the gas lines might be determined hourly by the computer and placed directly into the customer service computer system.

This more scientific approach should be considered as a dynamic forecasting method. The equations would be internally reviewed, and when unacceptable variances between forecast and actual performances began to appear, the multiple correlation analysis would be repeated.

Research indicates that substantial improvement in forecasting can be achieved by use of the procedure described. The big problem is to obtain data for the correlation analysis and to recognize the proper independent variables.

Another forecasting method that could be used to project demand requirements is the "smoothing technique."<sup>10</sup> In certain cases smoothing was found to be more effective than multiple correlation. Actually, however, the solution to

<sup>9</sup> Customer complaints that are caused by the malfunctioning of the space heating equipment of the customer.

<sup>10</sup>  $\text{New Average} = (\text{new demand}) + (1 - \text{old average}).$

forecasting service orders does not lie with one technique but with a combination of techniques. Depending on the nature of some of the categories of demand, multiple correlations or smoothing might do most to shed light on future demand. The choice of forecasting method must be made individually for each category of demand.

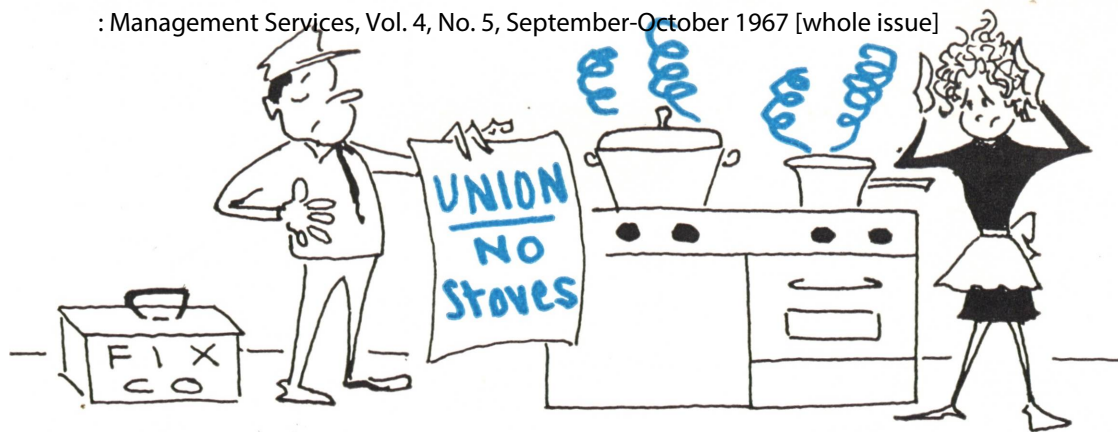
For the updating of demand requirements throughout the day the use of frequency distributions of hourly demand for ranges of daily demand is a promising forecasting technique. Once the demand forecast is made (say, 7,000 orders), one can review the hourly build-up of orders for past days and end up within the same range of orders (say, 6,950 to 7,050). With the use of confidence intervals, a utility can then state with some degree of confidence what the chances are on an hourly basis to obtain the 7,000 orders.

Service demand doesn't just happen. It is caused. Thus, it can be forecast with some degree of confidence. Many of the categories of demand that were forecast for the utility studied were items that were originally felt to be unpredictable.

*Scheduling system* — Scheduling is a generally recognized problem. There have been, however, many valid reasons for inefficient scheduling in the past. Some of these, as was indicated earlier, center around the inability of management to recognize the exact location of each request and at the same time to know where each serviceman will be located, his classification, the estimated work load, and the expectations for future work.

The development of a scheduling system will be discussed in four parts: the development of a block coordinate system, the assignment of servicemen to districts, the initial assignment of service orders, and the daily order assignment being dispatched.

*The development of a block coordinate system*—The goal of the block coordinate system is not only



Union classifications limit the extent of work that each serviceman can perform. Service requests must be distributed only to those authorized to perform the service.

to pinpoint each customer request in the city but also to develop a means of calculating mileage between each service request. At the utility studied this initially was done by the use of a one-mile grid system. The entire service area was divided into one-mile grids. The next step was to list each street and range of house numbers for each grid. Once this was directly accessible from the computer, the pinpointing could be calculated by the numbering system of the grids, as shown in the diagram at right.

Further analysis indicated that although one-mile grids were of ample size for the data accumulation part of the scheduling scheme, smaller grids would provide even better scheduling. For example, if five service requests came in for grid 10-20(A), the computer could not distinguish among the locations of the orders. Consequently, assuming like priorities, the service orders would be scheduled on a random basis. For this utility, the smaller grid system was shown to be more economical (because it provided more consistently correct scheduling) than the one-mile-square grid.

It is interesting to note that many cities have been numbered on a block coordinate system by the city planning groups. This means that the numbers assigned to the streets are a function of the

block location. Thus, streets running north and south have the same range of numbers. This makes the task of assigning block coordinates to the customer accounts relatively easy.

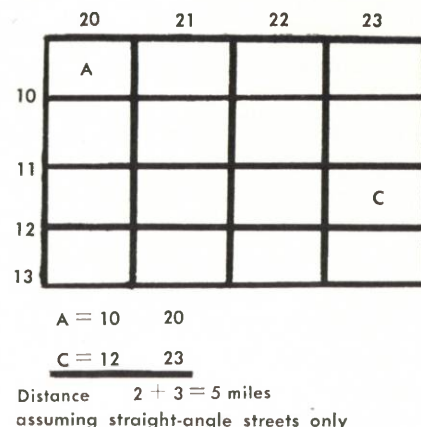
*The assignment of servicemen to districts*—For control purposes and for better routing, servicemen are usually assigned to districts. Sometimes the district boundaries make sense, for example, an expressway with very few crossing bridges. But other division lines are quite arbitrary.

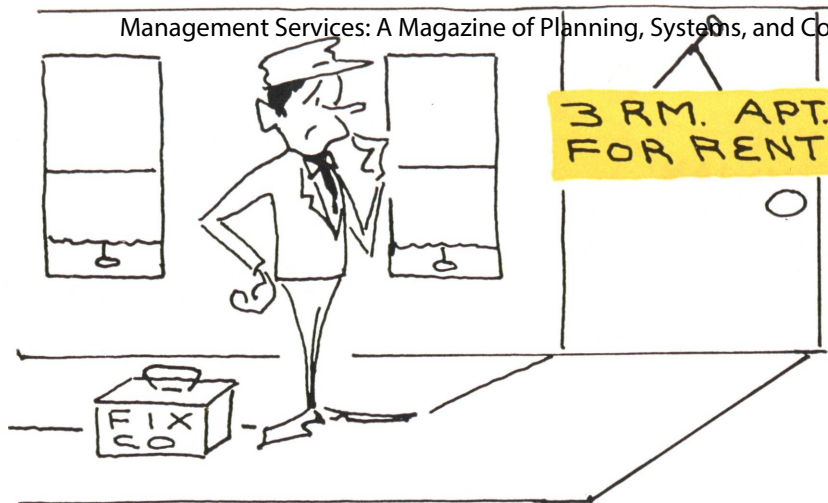
Although most utilities recognize the necessity for shifting servicemen among districts to meet fluctuating demands for service, the movement is far from free. The problem results from inability to assess the work load in each district at any given time and the loss of control when servicemen are shifted among districts.

With an on line-real time system there is little reason to think in terms of districts so far as scheduling is concerned. The total number of servicemen by classifications available to the home base can be assigned by use of one-mile grids within each district. The use of a linear programming technique such as the transportation (allocation) model permits the optimum assignment to be made and the optimum number of servicemen and classifications by district to be determined.

If the assignment of servicemen to districts is not correct, the linear programming model will require shifts of servicemen among districts. By analyzing these shifts, it is possible to make permanent transfers of the servicemen from one district to another. In this way the optimum number of servicemen and their mix of classification can be established.

One of the constraints on the linear programming model is that at least one serviceman of each classification must be located within each specified area. This was necessary at the utility studied because emergencies might require a certain classification of serviceman to arrive at a given location within a relatively short period of time. Without this constraint, it would be possible to have an area of, for example, 18 square miles without





The most common cause for repeated trips on a service call is failure to make a firm commitment to a customer for a reasonable time of arrival.

a single serviceman with the proper classification and skill to repair a gas leak at an industrial plant.

*The initial assignment of service orders*—At the beginning of each day service orders can be automatically sorted by one-mile grid locations, by classification of work, and by priority. The problem is to distribute the orders to the servicemen that will be working on that particular day. The goal is to minimize both the travel between orders and the execution of orders by overclassified servicemen (high-classification servicemen doing low-classification work).

Assuming a world of certainty, that is, ability to forecast the day's demand properly, to estimate the standard times, to perform service work and travel time at standard, and to foresee all contingencies, the solution would still involve a very complicated simulation or linear programming formulation. Fortunately, the manager can justify a less sophisticated solution in the real world; and, although he may not arrive at the optimum solution, there are some relatively simple procedures that can be utilized to improve initial assignment.

The problem of assignment of orders to servicemen can be solved roughly by computing the number of standard minutes of each class of

work for each grid. Expected dispatched service calls can be estimated by analysis of historical patterns of calls and should be included with the backlog of service calls in the morning. Starting with the lowest classification of work, the men can be assigned to the grids having the largest number of standard minutes of work. The next step is to consider the remaining service work at the lowest classification as one classification higher and assign to it the next higher classification of servicemen — and so on until all servicemen are assigned. More sophisticated methods can be used, but the method described will at least place the serviceman in the areas most saturated with work to be done.

The problem of sequencing of work orders is a function of priorities and the attempt to minimize travel between orders. The branch and bound method<sup>11</sup> and various other methods can be used. At the utility studied workers<sup>12</sup> developed their own method, one that appeared superior to the methods previously mentioned.

<sup>11</sup> See for example Norman Agin, "Optimum Seeking With Branch and Bound," *Management Science*, December, 1966, pp. B176-185.

<sup>12</sup> Thomas Sarowski, Arthur Andersen & Co., and Dennis Berry, Michigan Consolidated Gas Co.

*The daily order assignment being dispatched.* As the service calls are received, they can be placed directly into the computer. The computer evaluates the present workload and determines when the commitment can be made, taking into consideration the priority of the work. Assuming that the work can be completed on the day received, it is assigned to the best serviceman, based on his classification, location, work load, and special skills. These orders are batched, and when the serviceman makes his regular call to the dispatch board, the orders are integrated into the unexecuted orders held at that time by the serviceman. All of the orders are then sequenced, using the procedure described previously.

All orders before being dispatched are checked against the routine work file. If routine work is required at the same premises, both orders are dispatched at the same time.

### *The system in operation*

Not all the segments of the system proposed in this article are economically justifiable in all utilities. In fact, the actual system developed for the utility studied differed somewhat from the one described because of modifications necessitated by the utility's unique characteristics and by the economics of certain segments of the system.

The system discussed in this paper is unusual in that all pertinent data required for decision making by the department are directly accessible from the computer. Furthermore, the data are manipulated by the computer so that certain types of decisions can be made by the computer.

The most important element of the system is its ability to improve control over the servicemen in the field. Many of its benefits stem from the fact that servicemen for the first time are aware that management can evaluate their performance promptly and accurately.

*Inventory control is a perpetual problem to management. Yet in many cases the trouble lies in inadequate distinction between replenishment stock and safety stock, with the latter used as replenishment —*

## **SAFETY STOCK: KEY TO EFFECTIVE INVENTORY MANAGEMENT**

*by Matthew C. Fox*

*Lybrand, Ross Bros. & Montgomery*

**A**S A SOURCE of consternation, confusion, and complaints in the executive suite, inventory has few peers. Many of the problems attributed to inventory are peculiar to the companies that have them. There is, however, a persistent complaint that crosses enough company boundaries to be considered universal, namely: Why does inventory investment seem to increase at the same time that customer service drops?

The culprit is safety stock, or,

more precisely, the people who corrupt its purpose and thereby generate the paradox that confounds management.

The main purposes of inventory are to provide a reservoir for service to the customer and to act as a buffer between sales demand and production. Inventory, then, can be considered in two segments: a working inventory that is large enough to cover usage during planned replenishment cycles (lead time) and a safety stock to ac-

count for the fluctuations in demand.

### ***Accordion effect***

When safety stock is used to cover mistakes in taking replenishment action rather than as a means of accommodating sales fluctuations, an adverse accordion effect reaches back into the production lines. The problem is born when a late replenishment shipment to a branch causes a stockout. Antici-

**Errors in lead time, which could be corrected by earlier placement of orders . . .**

pating a delay on his next order, the branch manager, to protect himself, increases the amount of the next replenishment order. When it comes in, the branch will have more safety stock than it needs. The increased load on the plant eventually causes a late delivery at another branch.

Within a relatively short period the branches are operating at two levels of service. When deliveries do arrive on time, the branches are overstocked, but as much as 25 per cent of the time they are in an out-of-stock condition.

This phenomenon can be graphed by plotting the number of orders received against the size of each order, using a normal distribution curve. Two characteristics can be used to describe the resultant curve: the standard deviation and the mode. The standard deviation, a statistical measure of the variability of demand, is determined by measuring the errors or fluctuations in demand. The mode is the most frequently placed order quantity. If the most frequently or-

dered quantity is 100 pounds and the standard deviation is 15 pounds, the resulting graph is as shown in Exhibit 1 below.

**Example**

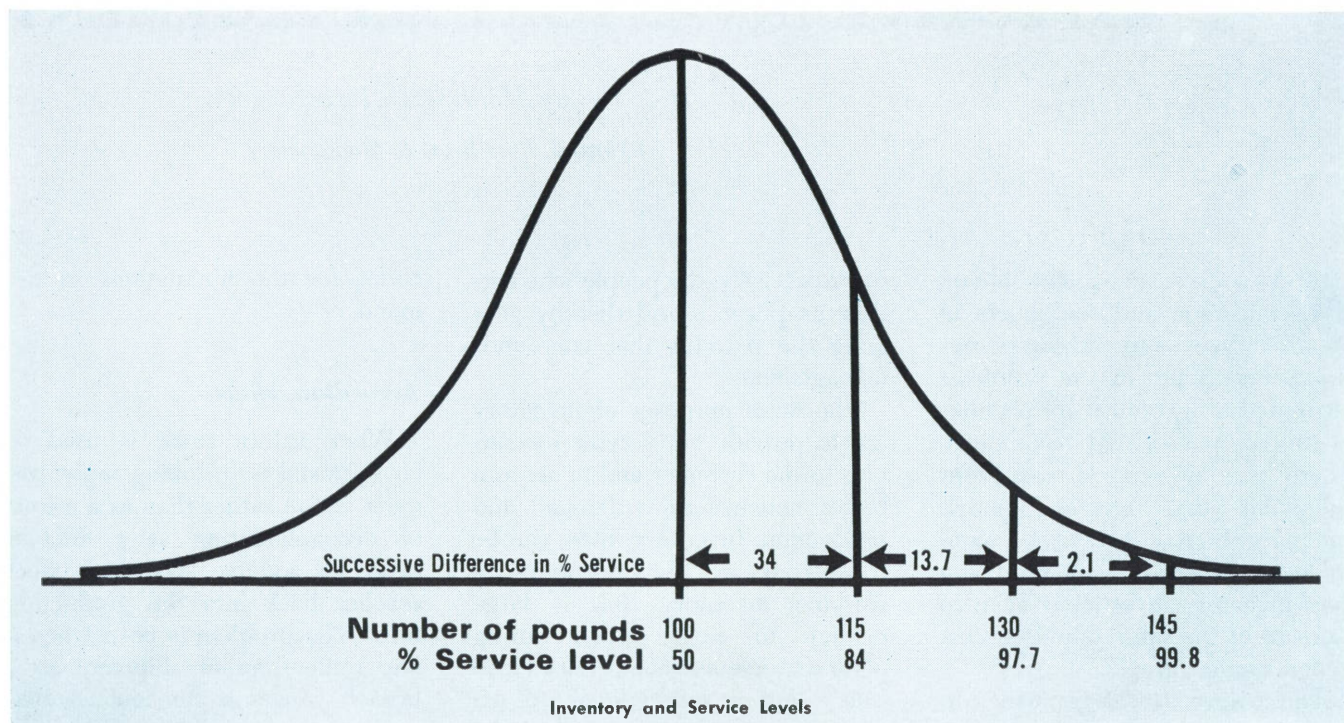
If we stock 100 pounds, our service level is 50 per cent. That is, we can satisfy every order to 100 pounds or less and no order for greater than 100 pounds. If we now stock an additional 15 pounds as safety stock against larger orders, we can satisfy all demands below 115 pounds; our service level is 84 per cent (the probability that an order will be less than 1 standard deviation more than our most frequent order). If we add another 15 pounds, stocking 130 pounds in inventory, we raise our service level to 97.7 per cent. Carrying 145 pounds increases the service level to 99.8 per cent.

If we want to achieve a uniform service level of approximately 85 per cent, all branches would normally carry 115 pounds. If the plant were to miss a shipment to

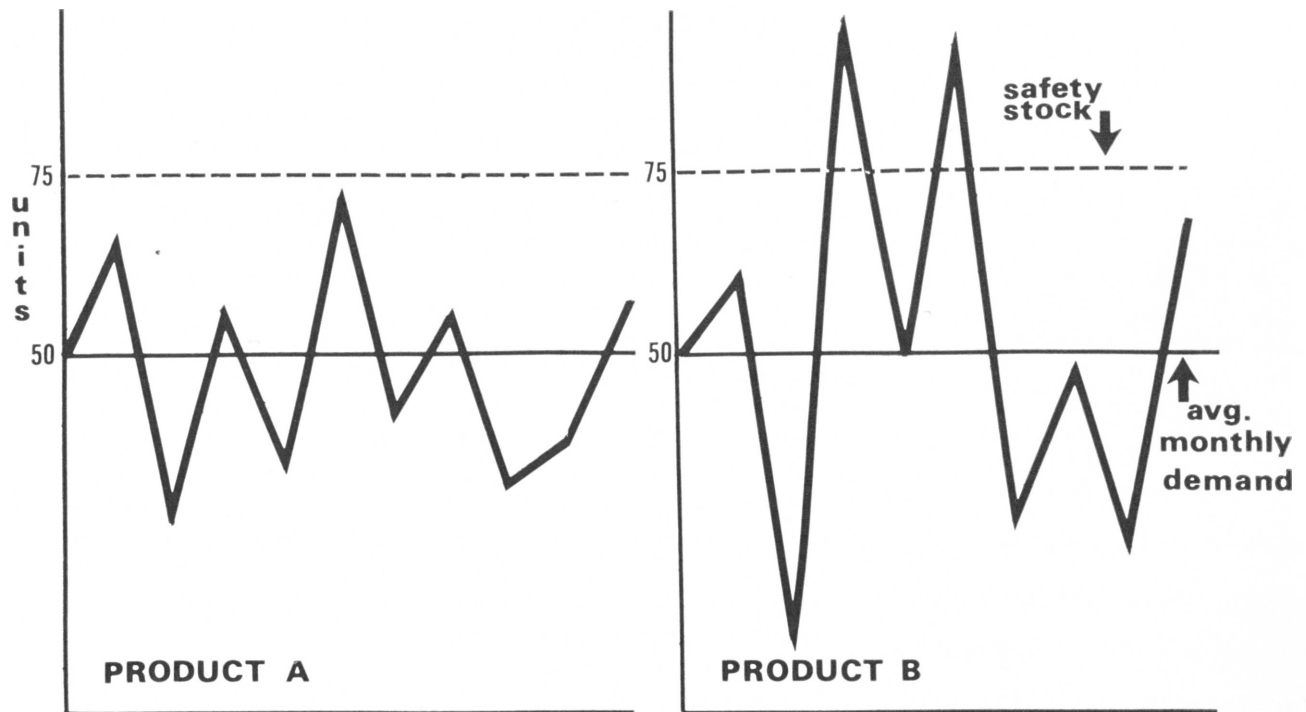
one branch and the branch ran out of stock, the natural reaction of the branch manager might be to order more because "... 115 pounds is not enough." Thus, if normal replenishment occurred every month and in this case delivery was a week late, the branch manager might well request an additional 30 pounds (to cover the extra lead time).

The next shipment, then, would not be 115 but rather 145 pounds. If it arrived on time, the service level at Branch A would be 99.8 per cent. But if the plant delayed shipment to Branch B to satisfy the extra 30 pounds ordered at Branch A, the service level at Branch B would drop. The extra 30 pounds, then, would add only 16 per cent service to Branch A while dropping service at the second branch to zero for one week. At Branch A the difference between 130 and 145 pounds would increase the service level from 97.7 per cent to 99.8 per cent. At B those same 15 pounds would have increased service from 50 per cent to 84 per cent.

EXHIBIT I



... are distorted into larger requisition quantities. Result: excessive safety stock



Safety Stock or Minimum Quantity =  $1\frac{1}{2}$  month's average = 75 units

Demand Stability and Safety Stock

EXHIBIT 2

What we have seen here is a reflection of what one normally finds in the field. Errors in lead time, to which the response should have been earlier placement of orders, are distorted into larger requisition quantities, resulting in excessive safety stock.

**High-volume items worst problem**

This condition is particularly prevalent with high-volume, fast-moving items that need constant replenishment action. Low-volume items are less prone to this problem. Normally produced in quantities that represent many months' supply because of the economics of manufacturing, excess reserves of low-volume items are normally justified by the requirements for minimum production quantities. Late delivery is not usually a problem, and stockouts, while trouble-

some, do not disrupt customer service to anything like the same extent as do stockouts in high-volume products.

**Demand fluctuations**

One indication of the problem of lead time/safety stock distortions is that it is normal to hear safety stock spoken of in terms of "weeks of coverage." It should be evident, however, that for an item whose rate of sales shows little or no fluctuation, the reserve for fluctuation in demand should be close to zero. Defining safety stock in "weeks" is a fallacy because there is no relationship between it and size of demand; the variable is stability of demand. In some cases "one day's" coverage is too much; in other cases "one month's" coverage is insufficient.

In Exhibit 2 on this page both

items have a monthly demand average of 50 units. Product A exhibits a relatively stable pattern, and a safety stock of 10 units should be more than sufficient to cover fluctuations in demand. Product B, however, displays an erratic pattern, and the safety stock level here would have to be 45 units. Obviously, "one week's" coverage (ap-



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proximately 12 units) would be adequate for Product A but extremely short for Product B.

When an inventory contains hundreds or thousands of items, it is usually not possible to distinguish between those products that resemble Product A and those that resemble Product B. Normally, there is a general "feel" for the inventory: It is either adequate or it is not. The tendency, therefore, is to apply a "number of weeks" coverage rule across the board.

The result is that all items, the Product A's and Product B's alike, have high safety stock levels. As the safety stock levels are pressured upward to reach the upper limits of the erratic item demand patterns, the amount of dollars invested in inventory becomes excessive. There is then a corresponding downward pressure on the part of financial management to restrict further inventory investment.

The general result then is that inventory levels for relatively stable items, although low in terms of coverage, are greatly in excess of that which is required. Yet this excess in most cases goes unnoticed because these items normally have a high inventory turnover.

If one of these items has a supply adequate for six weeks when only four weeks' reserve is necessary, the inventory for this item is some 33 per cent excessive. Correspondingly, the item that has ten weeks' supply but needs eleven is 10 per cent short. Thus it is that despite climbing inventories, back orders do not decrease. Pressure by the sales force can legitimately exist side by side with opposite pressure from the financial group.

#### ***Effect on production***

The inventory imbalance will often cause severe problems in the plant before any corrective steps are taken in the inventory management area. As was noted, field inventory levels vary between excessively high service levels and no service at all. As the swing between stockout and overstock

widens, affecting more items and more branch locations, the inventory loses its ability to act as a buffer to production. More and more items are back-ordered, and "hot lists" begin to appear in the shop. Once this happens, manufacturing management is no longer able to produce economically. Production schedules begin to swing wildly, further perpetuating inventory imbalances.

The great danger at this point is that the problems caused in production may appear more critical than the accompanying low sales service or high inventory levels. (This is especially likely in industries with high set-up and overtime premium costs). Then, measures are taken to change production scheduling and control rather than to correct the primary problem of inventory control.

#### ***Savings potential***

The misunderstanding and consequent mismanagement of safety stock also accounts for the fact that safety stock—not obsolete stock—usually presents the greatest opportunity for inventory savings. When management learns of excess inventory, it usually assumes erroneously that the excess consists of obsolete or surplus stock. In a typical situation an inventory was reduced by more than \$2 million. Only \$400,000 was obsolete stock, and in this case less than 10 per cent of the inventory was in excess of 3 months' supply. The savings came from adjusting safety stock levels to conform with forecasted fluctuations in demand.

The problems cited are commonplace. They demonstrate that despite the generally advanced state of inventory management in industry, the function of safety stock is not fully understood. The ramifications of mismanagement of safety stock are so pervasive that, as a rule of thumb, management is well advised to check safety stock policies and usage when problems crop up in seemingly unrelated operations.

***As the swing between stockout and overstock widens, affecting more items and more branch locations, the inventory loses its ability to act as a buffer to production. More and more items are back-ordered and "hot lists" begin to appear in the shop. Once this happens, manufacturing management is no longer able to produce economically.***

*Any investment always involves an estimate of the expected rate of return. But no one can guarantee that the estimate will be correct. What a company can do, however, is calculate the possible degree of error in its estimate and weigh this against the alternative uses of its capital —*

## USE OF SENSITIVITY ANALYSIS IN CAPITAL BUDGETING

*by William C. House*

*Texas A&M University*

**T**HE ANTICIPATED rate of return on investment is one of the principal criteria used by corporate managements in deciding whether to accept or reject a proposed capital expenditure. Like any forecast, however, the rate of return estimate may prove to be inaccurate.

Estimates of rates of return are based on forecasts of such elements as sales volumes, selling prices, product purchase or production prices, operating expenses, capital investment outlays, and project economic lives. Any or all of these forecasts may be erroneous, and the result may be an actual rate of return that falls far

below what has been anticipated.

Thus, management needs some method for determining the likelihood and amount of such errors before making a final decision to accept or reject a given proposal. It is sometimes possible to develop probability distribution curves that indicate the likelihood of occurrence of specific rates of return for individual projects. If enough information is available about the outcomes of similar past proposals, then management can make its choice on the basis of expected values (i.e., the values with the highest probability of occurrence) derived from a probability distribution of rates of return. In many

cases, however, capital investment proposals represent unique events for which there is little or no relevant past experience. Then expected values cannot be determined objectively, and the likelihood of errors cannot be predicted.

It is always possible, however, to calculate in advance what effect errors in estimation would have on the estimated rates of return and thus to determine the significance of such errors. The appropriate technique to use is that of sensitivity analysis. Its application, illustrated by means of a case example, is explained in this article.

Analysis of the sensitivity to er-





Sensitivity cannot be measured precisely. Management may have to ignore the fact that a change in one estimate (e.g., sales volume) may cause changes in another estimate; such changes are difficult to measure.

ror of rates of return is the process of determining whether small changes in various estimates cause significant changes in estimated rates of return. If management finds that a 5 or 10 per cent error in forecasting a certain estimate (e.g., production costs) will cause the estimated rate of return for a given project to decline below the estimated rate of return for a competing project or below a prescribed minimum figure, it will probably decide to investigate more thoroughly the likelihood of changes in production costs before making a final decision to accept or reject the project under consideration. On the other hand, if management discovers that a relatively large error (e.g., 25 or 30 per cent) must occur in forecasting production costs before the estimated rate of return is affected significantly, then further efforts to reduce errors in forecasting production costs may not be deemed economically justifiable.

Even when estimated rates of return are sensitive to errors in certain estimates (i.e., a small change

in an estimate causes a significant change in the estimated rates of return), management may not always be able to reduce significantly either the likelihood or the impact of estimating errors. However, knowing the conditions of sensitivity puts management in a better position to decide if the risks are large enough to cause the rejection of investment proposals under consideration.

### Measurement

The sensitivity of estimated rates of return to errors in estimates cannot be measured precisely for several reasons. First, management must base its analysis of the relationships among the variables which affect the rates of return on past experience; these relationships, however, may not hold completely true in the future. Second, in its examination of the sensitivity of rates of return to errors in estimating individual variables, management may have to ignore the fact that a change in one estimate (e.g., sales volume) may cause changes in another estimate (e.g., operating expenses) because such cause and effect relationships are difficult to measure. Third, autocorrelation<sup>1</sup>

may exist between two or more estimates for a given variable, distorting what appears to be the sensitivity or insensitivity of estimated rates of return to errors in estimation.

Thus, lack of actual data on how one estimate will vary if another is altered may make it difficult for management to determine the precise effects of errors of estimation on estimated rates of return. However, management does not need to know precisely the sensitivity of estimated rates of return to errors in estimation. If the relative differences in the effects of errors in estimating various elements can be determined, management will be able to identify the estimates that deserve further attention. Selection of estimates to investigate more thoroughly can be made on the basis of whether or not the sensitivity of estimated rates of return to errors in any given estimate is significant.

### Significance

How can management determine whether a significant degree of sensitivity of rates of return to errors in estimation exists if sensitivity cannot be measured precisely? Two major guidelines are helpful. First, a stated degree (e.g., 10 per cent) of error in an estimate must cause the estimated rate of return for a proposal to decline below that for a competing proposal or some prescribed minimum figure. Second, the stated degree of change in the estimate being considered must be within a range of error (e.g., 10 per cent) considered to be feasible, based on management's past experience or its subjective evaluations. When both these conditions are met, the sensitivity of rates of return to errors in estimation can be said to be significant.

If the sensitivity of a measure of return to errors in a given estimate is significant (i.e., a stated degree of error in the estimate would cause management to reverse its decision to accept a given proposal), what can management



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<sup>1</sup> Autocorrelation is, to a certain extent, the dependence of the estimated value of a variable in one year on the value of that variable in a previous year. Thus, a 5 per cent change in selling prices in one year may actually cause a change of more or less than 5 per cent in selling prices the next year. See Michael J. Brennan, *Preface to Econometrics*, Southwestern Publishing Co., Cincinnati, Ohio, 1960, p. 348.

do? It should examine such estimates more thoroughly or collect more information in an effort to reduce errors in forecasting and the likelihood of making the wrong choice.<sup>2</sup> It may need to recalculate the estimates of rates of return on the basis of new underlying data, perhaps using discounted measures of return.

The changes that occur in estimated rates of return when the basic estimates are changed are difficult to compare for two reasons. If the estimated rates of return for the different projects vary widely, the same amount of change in estimated rates of return for any two given proposals may not have the same significance for both proposals. If both simple and discounted rates of return with different original values are calculated for each proposal, the changes in these values caused by any particular error in estimation may not be comparable. To solve these problems, the sensitivity of estimated rates of return to errors in estimation can

be measured in terms of the percentage increase or decrease from base-case values for rates of return resulting from errors of a given size.

More valid comparisons of the sensitivity of different estimated rates of return to errors in the estimates for the same project or of the same rates of return for different projects can be made by stating the change in the estimated rates of return as a function of a percentage deviation from the original estimated values. This approach surmounts many of the difficulties ordinarily encountered in comparing rates of return for projects of different sizes and/or different measures of return when base-case values are different.

### Case example

The following case example illustrates some of the significant aspects of the application of sensitivity analysis applied to a capital investment decision. The table on this page shows the discounted cash flow rate of return for an oil company manufacturing project based on original estimates or base-case assumptions. The effects of 10 per cent changes in various estimates used to compute the discounted cash flow rate of return are also shown. It can be seen that 10 per cent errors in certain estimates (sales prices and raw materials costs, for example) are much more significant than errors in other es-

timates in terms of their effect on the discounted cash flow rate of return.

Let us assume further that the management of the oil company in question has established a cutoff rate of return of 8 per cent for all manufacturing projects. The base-case discounted cash flow rate of return for this proposal is 12 per cent, well above the cutoff rate. If the base-case estimates are used to compute the discounted cash flow rate of return, the project will probably be accepted.

However, a 10 per cent decrease in sales prices or a 10 per cent increase in raw material cost will cause the discounted cash flow rate of return to decline below the cutoff rate of 8 per cent. Therefore, an investment decision based on the discounted cash flow rate of return in this case is sufficiently sensitive to errors in estimates of sales prices and raw materials costs to justify further investigation of the accuracy of such estimates before accepting the proposal in question. Errors of 10 per cent in the remaining four estimates do not cause the discounted cash flow rate of return to decline to or below the cutoff point. Therefore, further investigation of the accuracy of these estimates is not required.

If there are no formal cutoff points in effect, the percentage changes that occur in the discounted cash flow rate of return when various estimates are altered by a fixed percentage can be used

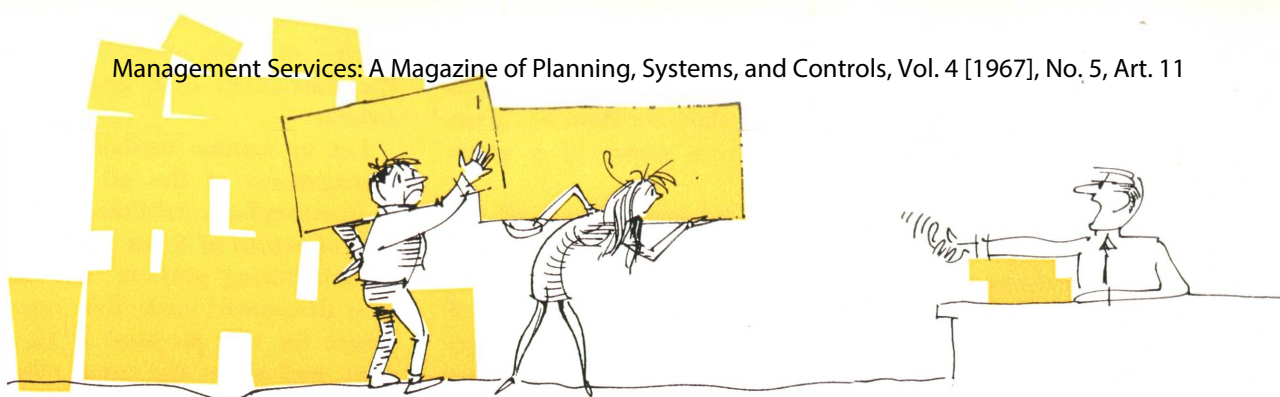
<sup>2</sup> An incorrect decision is one that management could have avoided if more complete information about the future had been available. It may be possible for management to reduce its uncertainty about expected values of estimates by applying managerial resources to the task of improving its accuracy in forecasting. This, in turn, would decrease the likelihood of management's selecting projects which would have been rejected if more complete information had been available.

Sensitivity Analysis of a Manufacturing Project

Likely Maximum Error in Given Estimate	Discounted Cash Flow Rates of Return <sup>1</sup>			
	Base-Case	Base-Case Revised	Increase (Decrease)	Percentage <sup>2</sup> Change
10% decrease in estimated sales prices	12.0%	4.7%	(7.3)%	60.8%
10% decrease in estimated sales volume	12.0%	10.1%	(1.9)%	15.8%
10% increase in estimated low material cost	12.0%	7.4%	(4.6)%	38.3%
10% increase in estimated processing cost	12.0%	11.6%	(0.4)%	3.3%
10% increase in estimated overhead/maintenance cost	12.0%	11.4%	(0.6)%	5.0%
10% increase in capital investment	12.0%	11.2%	(0.8)%	6.7%

<sup>1</sup> Based on an estimated economic life of 20 years

<sup>2</sup> Calculated by dividing the increase or decrease in the discounted cash flow from the base-case figure by the base-case discounted cash flow rate of return



If sensitivity of a measure of return to errors in a given estimate is significant, management can collect more information in an effort to reduce errors in forecasting and the likelihood of making the wrong choice.

as a gauge of the significance of such errors. In the case cited, a 10 per cent decrease in estimated sales prices causes a 60.8 per cent decrease in the discounted cash flow rate of return (from the base-case figure) and a 10 per cent increase in raw materials cost causes the discounted cash flow rate of return to decline 38.3 per cent. A ten per cent decrease in sales volume causes the discounted cash flow rate of return to decline by 15.8 per cent. Errors of 10 per cent in processing cost, overhead/maintenance cost, and capital investment cause the discounted cash flow rate to decline by 7 per cent or less.

These results indicate that a decision to invest in this project (on the basis of the discounted cash flow rate of return) is very sensitive to errors in estimates of sales prices and of raw materials costs and moderately sensitive to errors in estimates of processing cost, overhead/maintenance costs, and capital investment. Assuming that management cannot investigate the accuracy of all estimates more thoroughly, it would seem advisable to concentrate on the most significant estimates (i.e., sales prices, raw material costs, and possibly sales volume.)

Some would argue that much the same information as that shown here can be obtained using conventional breakeven analysis. How-

ever, the use of a discounted measure of return within the sensitivity analysis framework offers several important advantages. First, it permits cash flows to be related to invested capital; this cannot be done easily with breakeven analysis, and the productivity of capital may be impossible to portray in a meaningful manner. Second, it gives consideration to the time value of money while breakeven analysis does not. Finally, breakeven analysis is based on the assumption that the variables being considered are linearly related. In actual practice this may not be true. The sensitivity analysis approach does not require a strictly linear relationship among the variables being considered.

#### *Implications for management*

Determining, among a selected group of estimates, those in which errors have the most significant impact on measures of return and identifying cases in which calculation of discounted rates of return gives significantly different results from calculation of simple measures of return could be extremely helpful to management. It would indicate which estimates must be forecast more precisely than others if a correct investment decision is to be made and when the use of a discounted rate of return is eco-

nomically justifiable. Such information will aid management in allocating scarce managerial resources such as time, money, and effort to the process of measuring and reducing or eliminating the risks involved in capital budgeting.

The amount of information sensitivity analysis can convey to management is limited. The approach outlined here would not permit management to draw precise conclusions about possible combinations of errors in estimating significant variables and the resultant effects on estimated rates of return. Nor would it indicate what effect a change in one estimate might have on another estimate. Despite these drawbacks, information about the effects of errors in estimation on the choice of capital investments may be significant for management since it will often indicate where the greatest risks in making investments lie.

Fortunately, determinations of the sensitivity of rates of return to errors in estimates need not be precise to be useful to management. If the relative difference between the effects of error in various estimates on rates of return is known, management will often be able to determine which estimates deserve more attention than others and in what cases the use of discounted as opposed to simple rates of return is economically justified.

*The sheer volume of data makes it easy for advertising plans to go out of control in a multi-product company. Yet many of these companies have computer time available. Here's a simple EDP program that can offer good ad control —*

## **ADVERTISING CONTROL: A COMPUTER APPLICATION**

*by William T. Kelley*

*University of Pennsylvania*

**I**N A MULTI-product company with a number of separate advertising budgets it is difficult to control advertising expenditures. Yet some kind of control system must be instituted if the advertising effort is to be planned, directed, coordinated, and evaluated effectively.

Fortunately, the development of electronic data processing has greatly simplified this problem. The computer is ideally suited for tasks that involve the rapid manipulation of large quantities of data.

This article describes a computerized system for control of advertising expenditures that was developed for a large, diversified manufacturing organization. The system provides current budget control, costing information, accounts payable control, auditing reports, and statistical analyses of various kinds. Although it was designed for a large decentralized company, it also may have application in smaller companies where advertising is a significant part of the sales effort.

The company in which this system was instituted has a number of manufacturing divisions and a central advertising department that services the various operating departments. The products are divided among a number of product managers. A product manager may have only one product to market if the product is an important one—as measured by its sales volume or its contribution to profits—or he may have several (generally related) products if they are small and need less market planning and

## The advertising program can be modified as required, and a number of . . .

supervision. Sometimes a marketing manager oversees the work of several product managers. The latter also work closely with the appropriate sales managers, who direct field sales forces.

### *Product groups semiautonomous*

Each product or product group has its own marketing plan and its own advertising budget. Before the advent of the computer, detailed and timely budget control was difficult. Each advertising manager of a product or product group had to maintain his own records and controls, subject to the fiscal limitations imposed from above. Some did it well, some adequately, some poorly, and some not at all. Top marketing management never knew where it stood, for it was difficult to obtain an accurate picture of the whole advertising effort—how the plans were progressing, where the money was being spent, how much money was left in the authorized budget, how much was committed, and the like. Moreover, it was difficult to obtain an independent check of agency bills, media charges, printing and typography bills, and other expenditures for outside materials and services.

Later the company centralized its control and installed a hand tabulation system, run by a large

number of clerks. The clerks hand-posted to ledgers and drew data from the ledgers. Fifteen years ago advertising control was shifted to a punched card system. This made it possible to generate data more effectively, but the equipment provided what was mainly a data processing system rather than a means of analyzing and interpreting data for management control purposes.

### *EDP background*

The company has had a computer center for more than a decade. There are three high-capacity computers of different vintages, all knit together in a compatible system that in total has a very high capacity. The advertising control system requires only a small fraction of the total time available on the computers, so that the chargeback for computer services to the advertising department is surprisingly modest, considering the rich output obtained.

The computerized advertising control program was instituted in 1960 and built up gradually over the past several years. By now, as will be seen, a rather elaborate program has been built into the computer. It can be modified as required, and a number of specialized reports have been added without much difficulty.

New input data are accumulated and fed into the computer once a week. The system as it now stands is shown in Exhibit 1 on page 43 and Exhibit 2 on page 44. The input feeds into the left side of the diagram in Exhibit 2, manipulation and calculation processes take place in the middle of the diagram, and output emerges at the right.

The computerized system is run by virtually the same number of people as in the hand tabulation days although the volume of data processed and reports produced

has grown by a factor of about ten times since then. Thus, productivity per person in the section has multiplied many times, and personnel are used for quite different purposes, as will be explained later.

The best way to understand the advertising control system is to look first at the input—what kinds of data go in—and then to consider the output—what kinds of statistical tabulations and reports are produced and what use they are to management. Input items are listed in Exhibit 3 on page 45, output items in Exhibit 4 on page 47. The details of what happens in between, the data processing, will not be discussed here since the object of this study is to see the kinds of data useful to marketing management that such a system can produce rather than to show how the data are manipulated and processed.

### *Appropriation and budget data*

Each advertising manager is responsible for developing the budgetary proposal for the product or products for which he is responsible. He figures each budget for one year; it is reviewed quarterly. The product manager, in collaboration with the sales director, develops his marketing plan for the product, clearly stating the marketing objectives for the next fiscal year.

The advertising manager takes the marketing objectives and determines the part that advertising should play, in his opinion, to achieve the stated objectives. He translates this into specific tasks to be performed, developing an advertising plan for the product. He then decides which advertising instrumentality—space advertising, broadcast, direct mail, sales aids, etc.—can best perform each task. He also figures out how much sup-



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... specialized reports have been added without too much difficulty.

porting product publicity, which will be supplied by the public relations department, will be needed. He then quantifies the plan in order to help achieve the marketing goals: How many pages of magazine advertising are required? How many spot television impressions? How many flip boards, brochures, price lists, etc. will be necessary to aid the salesmen in achieving the sales goal? The advertising agency often assists the advertising manager with his advertising plan, especially when it comes to working out the media part of the plan.

Then the various units are given prices and converted into dollar amounts. A full-page advertisement in a certain magazine costs so much per page, and we will use X number of pages; creative work will take so many man-hours of art

service, so many man-hours of copy work, etc. The advertising agency estimates that it will need so much for other services, and so forth. A copy platform is worked out by agency and advertising manager, and it becomes the creative guideline in the advertising plan.

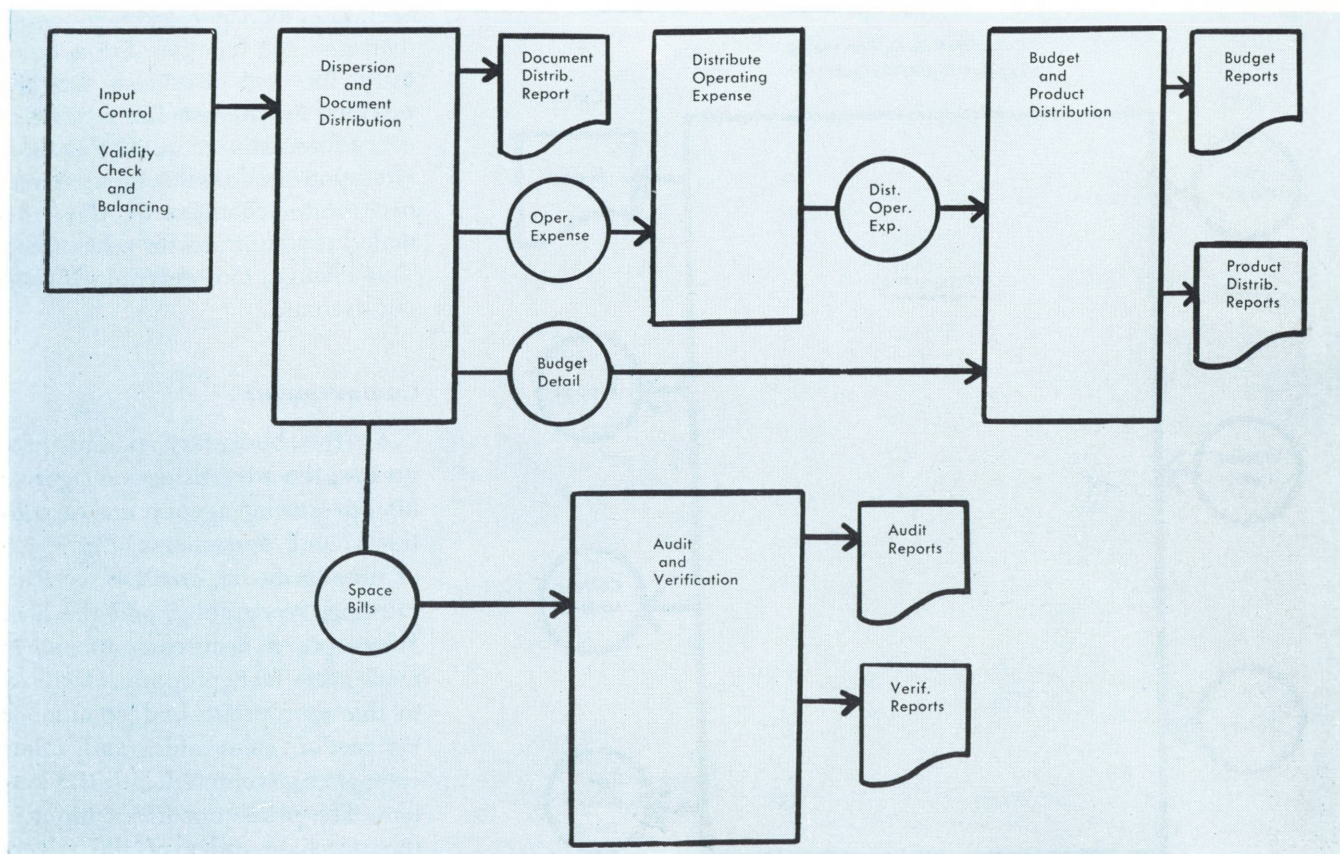
After the advertising tasks have been priced out, the budget proposal is put together and taken by the advertising manager to the sales director and the product manager. These executives may modify the proposal. Frequently the amount requested for advertising a product is deemed too great or is out of line in view of all other requests from the other advertising managers. The product manager knows what he plans to sell and how much he plans to make per unit after deducting manufactur-

ing costs. Therefore he knows the gross margin for marketing and profit on the product he has to work with. He and the sales manager also have ideas, based on past experience, about what is "normal" to spend for such a product (say, 2 per cent of sales). He also knows that he must hold all expenses down to rock bottom, just enough to do the job but no more, if he is not to impair his profit margin and return on investment.

Thus, the advertising manager, using the task method, builds up his estimate of what he thinks needs to be done and how much it will cost to do it that way. The product manager must balance all elements in his marketing mix—sales expense, sales promotion costs, and public relations support as well as advertising. Thus, in a sense the

EXHIBIT I

Accounting Department  
Data Processing—Budget System



advertising manager's figures from Magazine Advertising Planning, systems, and controls, Vol. 10, No. 7, originally planned, but the bottom up, and the product manager figures from the total plan downward. The latter knows what he can afford to spend, and this is the top limit of the advertising budget. If the advertising manager's proposal is no higher than that limit, he is all right, although his plan may be criticized on other grounds. If he exceeds the limit, he must have a strong justification for his proposal, indeed so compelling as to convince the product manager and his superiors to appropriate the extra funds. This seldom happens; usually the advertising manager must revise his proposal so as to cut it back.

After the product and sales managers have approved the advertising budgets, they go to the head of the manufacturing division for approval or revision. Then they go up to the executive and finance committees for final approval. Once that has been obtained, the advertising department has the authority to expend the funds.

After formal approval, and controls, Vol. 10, No. 7, originally planned, but the advertising budget becomes input to the advertising control system. The authorized sum is broken down according to plan by product line or brand and by each type of expenditure—print media, broadcast media, production (cost of printing, typography, plates, etc.), sales aids, direct mail, department overhead (share of).

### Allocation shifts possible

This "department authorized" column (see Exhibit 5 on page 48) becomes the control against which the advertising control people test actual expenditures. It is calculated for the whole year at the beginning of the fiscal year and fed into the machine. It is reviewed monthly by the advertising manager and altered as new market developments occur. The altered estimates become the "current estimate" column.

Perhaps the product in question does not need as much direct mail

a competitor is hurting the share of the market enjoyed in New England. After approval by the product manager, the advertising manager can reduce the current estimate for direct mail and increase the amount for spot television, which will beef up advertising support in New England where it is needed.

The advertising manager may make such shifts among items in his budget as long as the total amount authorized by top management is not exceeded by more than a certain percentage. This percentage is like a reserve, giving necessary flexibility to the budget while at the same time maintaining budgetary control over advertising expenditures generally. The advertising manager can also run over his budget in some periods and make up for it by running under at other times. The changes in the budget estimates in the form of a letter from the advertising manager are fed into the computer as they are made, thus keeping the input in the "current estimate" column as current as possible.

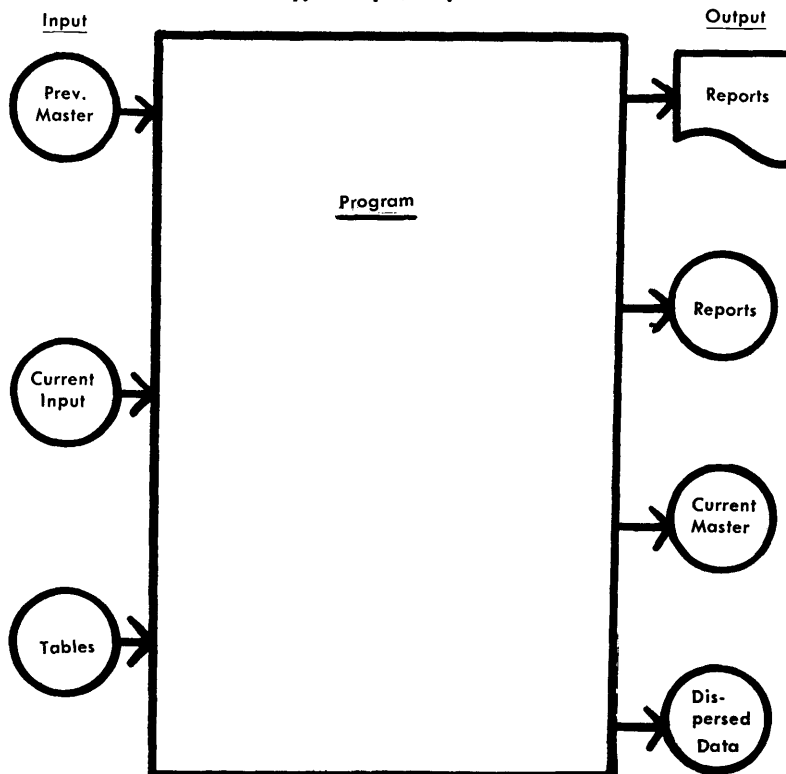
Every quarter the product manager, sales manager, and advertising manager get together for a quarterly forecast. Business for the product is forecast for a year at every forecast session. At this time, alterations in the sales forecast may necessitate changes in the estimated expenditures for advertising. This change, too, gets into the input system.

### Commitments

As the budgetary period progresses, the advertising manager or his advertising agency makes contracts and agreements for space or time in media, creative services, printing, typography, and the like. Whenever a firm commitment is made, this fact, properly classified to the appropriate budget number by media, sales aids, and other categories, is entered into the system. The prime document input is the purchase order of the adver-

EXHIBIT 2

Computer Data Processing  
Typical Input/Output Files



tising department or its equivalent.

As soon as the delivery of a product or accomplishment of a service is made under a commitment and the supplier sends his bill and it is verified and paid by the treasurer, this fact becomes input and is classified as expense against the budget applicable. At the same time the amount is removed (debited) from the "commitment" category.

### **Overhead**

Each advertising budget must be charged with its proportional share of the general departmental overhead. This includes input of rental of office space for the department and cost of joint facilities such as salaries of the department head, his assistants, and secretarial staff; storage of materials; etc. The estimated amount of overhead is programmed into the system together with instructions on how to allocate the overhead to the advertising budgets.

### **Tabular instructions**

As in any data processing system, instructions are programmed in as to what calculations to make, what tables to produce, and the like. This remains programmed in the computer, and changes are entered as appropriate.

### **Input control and validity checks**

A batch control system is used to cross check and test the accuracy of the input data. Other validity checks are imposed, such as numeric document checks and checks to make sure that direct expenses (e.g. space bills) are not charged to an overhead account, etc. It is important to have such checks on the quality of the input since errors will creep into any system.

### **Monthly budget report**

The principal output of the system is the monthly budget report,

which is the basic advertising control report. It is worked up monthly and is distributed to each advertising manager and product manager. It shows these executives exactly how their campaign is progressing.

The report breaks the funds down by product and type of expense (space, time, direct mail, sales aids, production, agency fee, etc.) and lists individual projects (e.g., XYZ campaign). The user of the report can run his eye across the column (see Exhibit 5) and see how much was authorized, the revised monthly figure, how much was committed (under contract agreement of some kind), how much was spent, and the balance unexpended as authorized by the budget.

This report has a number of uses: The advertising manager can see precisely how he stands — how much of the budget is authorized to be spent on each item, how much has been committed and expended, and how much remains to be spent. He can evaluate the progress of the campaign as a whole and of each part of his program. He can take action on parts that are lagging or slow down action on parts for which the funds are getting thin. It gives him a check on his agency's performance. That part of the campaign that is the responsibility of the agency can be perused and analyzed. Parts behind schedule can be highlighted for questioning.

Expenses running over the estimate can be probed into. The report flags the advertising manager down when he is overspent. If so, he must either stop future commitments or collaborate with the product manager to shift funds from other items in the budget to the one in trouble. The report also alerts him when he is underspent. He can then increase commitments for the item or shift the funds to some other place in his budget that needs help.

If the whole budget is reaching the "peril point," the limit allowed by top management for overexpenditure, say 10 per cent of the

Advertising Budget System	
Input Types	
1. A_	— Forecasts of Expenditures and Corrections to Audit and Verification Masters
2. B1	— Executive Committee Authorizations
3. B2	— Department Authorizations
4. B3	— Current Estimates
5. C_	— Commitments
6. E_ & F_	— Expenses Against Documents Identified by Source A. JEV's, CEV's, APV's, etc.
7. P1	— Print Indicators

EXHIBIT 3

total, he can then take quick steps to find out why. Perhaps it is because of inflation in prices of media, printing, or other services provided for in the budget. The reason may be uneconomical behavior by the agency. It may be poor management on his part—he simply has failed to keep proper account of things. Whatever it is, he can diagnose the trouble and take steps to correct it. This report gives him a sensitive and current indication of his status.

The report also indicates which part of an advertising campaign is coming along according to plan and which part is behind schedule. For example, on a calendar year basis, the July report may show that about 50 per cent of the total budgeted amount for magazine advertising has been spent on product X, just as planned, since uniform pressure is to be maintained on its market. But the figures reveal that only 20 per cent of the direct mail part of the plan has been expended. This leads the budget accountant and advertising manager to wonder about this figure and to investigate why it is so low. Sure enough, someone has "goofed" on that program, and attention must be paid to it in order to "pull it out of the fire."

Finally, the detail of the various items gives the advertising manager a chance to audit the charges if he wishes to do so. He probably will not do so since, as we shall see,



the advertising control system itself has an independent media audit.

The advertising manager can use the report to brief the product manager on the advertising program. From the briefings, the product manager can compare the progress of the various programs. He can spot areas that need his attention—peril points, underexpenditure, obviously poor progress of a campaign, etc.

The control section monitors the monthly report and brings excess expenditure situations to the attention of the relevant budget administrators. Thus, it exercises independent budgetary control and can flag down difficulties that otherwise might be missed by management.

#### **Budget detail report**

The budget detail report is prepared monthly at the same time as the monthly budget report. It gives the detail by individual vouchers of all advertising expenditures. It is used as an auditing tool by control and is an excellent cross reference. An internal report, it is not ordinarily distributed to the advertising product managers.

#### **Product distribution report**

The product distribution report has the same detail as the monthly budget report, but it is broken down by end use for important categories of products. It allocates direct expenses by each individual product. This gives the product managers control over advertising expenditures by each brand or product type. It aids them in calculating expenses against volume and in forecasting profit for each item for which they are responsible.

#### **Document distribution report**

A segregation of commitments and expenses is run to report on each advertising subcontractor of the company—advertising agencies, cooperative advertising contracts,

printing and typography vendors, direct mail firms, and the like. Job costing by purchase order is shown. This affords independent checks on the charges of suppliers. The progress of the cooperative advertising campaign is shown—amount committed or allowed for each account, account claims to date, amount unexpended. This report enables the advertising manager and sales director to check whether an account is overexpended or underexpended. In either case, follow-up action by a salesman with the contractor may be instituted.

#### **Audit and verification report**

The audit and verification report, a system to audit media charges, shows authorized and actual expenditures segregated by each advertising medium utilized. The report is distributed by budget number. The advertising manager responsible for the budget analyzes the report and verifies that each item shown has been delivered (or the ad run) as shown. Notation is made of exceptions. An exception might be black and white instead of color, wrong rate, wrong unit (full page instead of half page), etc.

Independently of the advertising manager's audit, the control section gets a tear sheet or station affidavit showing that the advertisement or commercial was run. The two audits may not agree. Suppose, for example, that the advertising manager has signified on his statement that the advertisement has been run in a certain magazine, but the control people have received no tear sheet or other evidence to verify it. Then the discrepancy is brought to the attention of the advertising manager.

The control personnel, who are specially trained in media rate structures (i.e. quantity and frequency discounts), audit the rate charges. Two rate auditors check agency bills to analyze whether the company has been accorded the best rate. They also look for good

***One company that has had an EDP control on its advertising allocation and expenditures for about a year now is the Armstrong Cork Company. Armstrong uses a "Control Card" for each category of advertising activity rather than an overall "Budget Report" as is suggested here, but in principle the two systems work in very much the same way.***

buys. For example, they may note that an advertising manager has run eleven advertisements in a magazine. By running a twelfth advertisement, he can qualify for an additional discount. The discount earned may all but cover the cost of the last advertisement. The control auditors will bring this situation to the advertising manager's attention. The computer cumulates the number of magazine pages used, newspaper linage, number of insertions, dollar disbursements by each medium, and the like. These totals are used by the auditors to check that the best rate, in view of quantity and frequency discounts, has been obtained. Auditors use rate cards, Standard Rate and Data Service, and rate contracts from media as their basis for the audit.

The audit also can reveal other discrepancies — the wrong unit charged for or cases in which the advertising agency was underpaid or overpaid for service charges, fees, etc.

For cooperative advertising, advertising control personnel audit to determine whether claimants have billed at the proper rate, e.g., whether the store has billed at the lower local rate or at the considerably higher general (national) rate. It also checks the validity of claims on the basis of sworn statements from radio or television stations that the spot announcements have been aired, publishers' invoices, tear sheets of advertisements, and other evidence that the advertisements in question are bona fide.

### ***Operating expense report***

The operating expense report provides a detailed breakdown as to how the advertising department overhead is distributed to advertising budgets and to products. If an advertising manager thinks his share is too high, he can spot where he thinks charges are excessive and perhaps get an adjustment. Top management can see how the overhead has been allocated and whether it unfairly penalizes the profits of some prod-

ucts to the benefit of other products.

### ***Other reports***

Since the basic input is available on the tapes in such great detail, almost any breakout that management wants can be provided. Several have proved useful to the marketing executives:

*The agency expenditure tabulation* is an independent check in great detail covering every expenditure made by the advertising agency on behalf of an account and costs billed to it for agency services. This makes possible a detailed audit of agency charges and provides good surveillance of agency cost performance.

*The cooperative advertising tabulation* recapitulates much of the material discussed above but affords additional detail. All accounts are printed out, and the status of each account's authorization, expenditures, and balance is given. It is most useful in controlling the always vexatious cooperative advertising program. Both sales and advertising managers are interested. The regional sales executives can be sent copies involving their particular accounts for

information and follow-up if they wish.

For the *duplicate payments report* the machine is instructed to match all payments by time and amount. It will print out all cases in which two ostensibly different bills were of the same date, were of the same amount, and/or were paid the same day. This simple comparison, so easy for the computer to make, has uncovered scores of overpayments and has been well worth the trouble and cost of making the run.

### ***Additional advantages***

There are other advantages that can result from computerization. One is payment control. Media bills from the advertising agencies are matched up with advertising department purchase orders and media schedules. If there is no match, payment is not authorized. This provides a check on the overpayment of agency bills or on unauthorized payment of the same. At the same time the computer makes a simultaneous distribution of overhead to budget accounts.

The system permits complete verification. Advertising control goes back to check after the fact.

## **EXHIBIT 4**

### **Advertising Budget System Reports**

1. Input Control
  - A. Input listing
  - B. Group totals
2. Document Distribution
  - A. Document number, description, and distributions
  - B. Current and to-date commitments and expense
  - C. Commitment balance
3. Budget and Budget Detail Reports
  - A. Department authorized and current estimates
  - B. Commitments and expense
4. Product Distribution
  - A. Budget and product code, description, and current estimates
  - B. Commitments and expense
5. Audit Report
  - A. Publication name and code
  - B. Contract period
  - C. Invoice number and date, budget code, production orders
  - D. Insertion date, description, actual and forecast amounts
6. Verification Report
  - A. Publication name and code, number of times ad is to appear
  - B. Invoice number and date, insertion date
  - C. Actual and forecast amounts

ADVERTISING BUDGET REPORT

Management Services: A Magazine of Planning, Systems, and Controls, Vol. 4 [1967], No. 1

DEPT. ABC

BUDGET XYZ PRODUCT LINE

DATE MONTH 2, 1964

TOTAL BUDGET COMMITTEE APPROVED 850,000

ACCOUNT CHARGE	DEPARTMENT AUTHORIZED	CURRENT ESTIMATE	COMMITMENTS	EXPENSES	BALANCE
8746 12 100 TRADE MANUFACTURER	37,200	35,600	21,463	1,845	12,292
8746 12 900 TRADE PREP MANUFACTURER	10,000	8,820			8,820
8746 12 901 TRADE 42345		400		414	14-
8746 12 902 TRADE 42567		780	780		
TOTAL	47,200*	45,600*	22,243*	2,259*	21,098*
8746 20 100 CONSUMER	56,400	78,600	1,562	58,830	18,208
8746 20 900 CONSUMER PREP	8,600	3,440			3,440
8746 20 901 CONSUMER 42781		2,420		2,294	126
8746 20 902 CONSUMER 42843		2,740		2,805	65-
TOTAL	65,000*	87,200*	1,562*	63,929*	21,709*
8746 40 100 RADIO	40,000	35,000		33,071	1,929
8746 40 900 RADIO PREP	1,000	1,500		1,202	298
TOTAL	41,000*	36,500*	*	34,273*	2,227*
8746 51 100 TV TIME NETWORK PARTICIPATION	500,000	380,000			380,000
8746 51 101 THE NURSES		50,000	49,900		100
8746 51 102 MONDAY NIGHT AT THE MOVIES		40,000		40,040	40-
8746 51 103 ROUTE 66		30,000	15,100	14,000	900
8746 51 900 TV COMMERCIAL PRODUCTION	70,000	49,600			49,600
8746 51 901 TV PREP 456789		9,500		9,400	100
8746 51 902 TV PREP 456790		10,900	10,947		47-
TOTAL	570,000*	570,000*	75,947*	63,440*	430,613*
8746 53 100 TV TIME - SPOT	80,000	80,000		55,000	25,000
TOTAL	80,000*	80,000*		55,000*	25,000*
8746 61 205 DMFM GENERAL MAILING NO. 1	3,000	3,500		3,507	7-
8746 61 210 DMFM GENERAL MAILING NO. 2	3,000	3,500		3,510	10-
8746 61 305 DMFM ABCD BOOKLET	1,200	1,200	1,109		91
8746 61 405 DMFM AD REPRINTS	1,200	1,200	1,187		13
TOTAL	8,400*	9,400*	2,296*	7,017*	87*
8746 70 105 EXH. ABCD SHOW	4,000	4,500		4,509	9-
8746 70 110 EXH. EFCH SHOW	6,000	6,200	700	5,500	
8746 70 900 EXH. WAREHOUSE	3,000	3,000	1,000	2,000	
8746 70 990 EXH. GROUP SERVICE	1,200	1,200	300	900	
TOTAL	14,200*	14,900*	2,000*	12,909*	9-*
8746 90 100 RESEARCH		10,000	10,000		
TOTAL		10,000*	10,000*	*	*
8746 98 100 OPERATING EXPENSE	24,200	24,000	8,000	16,000	
TOTAL	24,200*	24,000*	8,000*	16,000*	*
8746 99 100 AUTH. INCR. PER FORECAST	50,000				
8746 99 200 AUTH. DECR. PER FORECAST	25,000-				
8746 99 999 TEMPORARY CHARGES				201	201-
TOTAL	25,000*	*	*	201*	201-*
TOTAL	875,000**	877,600**	122,048**	255,028**	500,524**

EXHIBIT 5

Before the computer it was impossible to go back and check every invoice; there were simply too many for more than spot checking. Now literally every invoice can be checked for validity, duplication, and correct discounts.

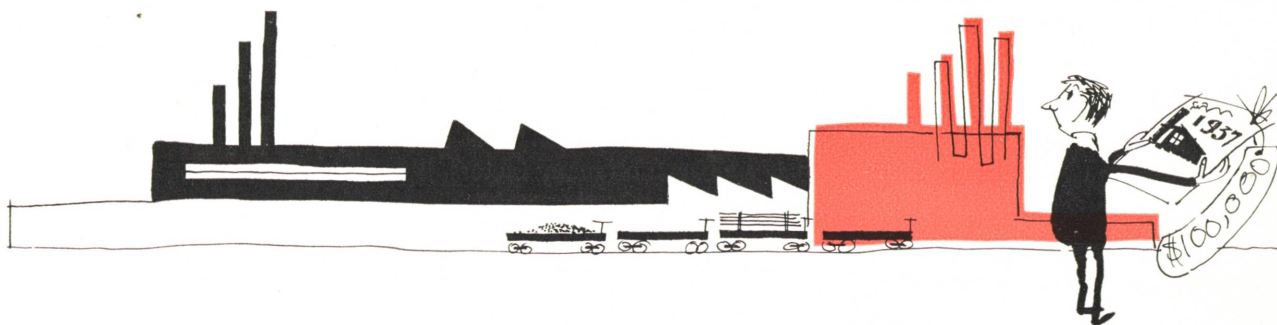
The system frees people for creative work. Before the computer system most of the efforts of personnel were occupied with the physical task of running the system, processing papers, and compiling reports. Now, most of the energies of the personnel are devoted to analysis and interpretation of the data. True control is assured. Moreover, people now have the time to plan for different reports, new ways of checking, addi-

tional by-product reports of further aid to management, and the like. This extra time for thinking about applications of the system has made the system much more valuable to management and pertinent to its problems.

Conclusion

Automated expense control systems using computers are feasible and have been of great utility in exercising cost control and in implementing sophisticated auditing procedures for advertising expenditures. Provision of current information in great detail has enabled advertising and product managers to take corrective action

quickly and decisively as emergency situations develop. It has facilitated advance planning and has made possible an effective follow-up on the progress of the advertising plan as it is worked out during the budgetary period. Surveillance by several independent offices—advertising, product management, advertising control—makes it less probable that overcharges, omissions, and the like will go undetected. Smaller organizations could certainly benefit from such an advertising control system, but it has become a “must” for the large, decentralized, multi-product company where, because of their number, marketing programs can easily get lost in the shuffle.



A \$50,000 investment in a subsidiary acquired 30 years ago may well be worth \$5,000,000 today.

*Merger negotiations require more of the CPA advisor than a conventional audit of the acquired company. He must take into account the potential of that company backed by the resources of the acquirer.*

## THE CPA'S ROLE IN MERGERS

*by David F. Linowes*

*Laventhol, Krekstein, Griffith & Co.*

**G**ROWTH through acquisition has been one of the most common methods of business expansion during the last two decades. The pace has accelerated to such an extent that completed mergers currently average about five for each working day and thousands of tentative mergers are worked on extensively each year but fall through for one reason or another during the latter stages of negotiations.

The acquisition psychology is

well known. After the last world war industry was faced with insatiable demands for its civilian products, and new supertechnology was ready for a giant lunge forward. Completely new products were signs of the times. To build production facilities, to develop research departments, and to create new products take much time, gifted manpower, and immense sums of money. Why not shortcut these painstakingly slow processes and acquire one or more companies

that already have all these things?

Why would a company want to sell? Sometimes a family business has no second line of command ready to take over management from aging founders or there are estate tax problems that make the cost of keeping the business in the family prohibitive. Sometimes a company finds that it is expanding beyond the limits of its working capital. Frequently one-product companies are eager to become part of multi-product companies to



Unrecorded assets and liabilities should be ferreted out and presented in the report of financial condition.

take advantage of the economies and efficiencies afforded by common selling and purchasing channels.

### *Auditing only part of role*

The very nature of a merger, which requires first establishing values and then integrating large masses of statistical data and administrative processes presents the imaginative CPA with great challenges and opportunities. These opportunities go beyond the conventional audit function. Important as it is, auditing is only a fraction of the total service a CPA may render if he also provides management advisory services.

The CPA's services in a merger or acquisition may be classified into distinct phases, conforming to the steps in such a merger program.

### *Valuation*

When an acquisition is in the preliminary stages of consideration, the prospective purchaser must try

to establish a fair price to offer for the company he seeks. This price may be based on many factors, but generally the starting point of all negotiating sessions is the financial statements. The audited financial statements, however, tell only part of the story. To be of maximum use to a purchaser, the selling company's statements should be recast to reflect a truer picture of present-day values than is normally shown on statements prepared in general accounting practice. Such recast statements become part of a pro forma report prepared by the CPA.

On the balance sheet there may be an item shown as a 50 per cent interest in a subsidiary acquired some 30 years ago. Today, that same subsidiary, originally valued at \$100,000, may have a net worth of \$10,000,000. Obviously, to properly show the value of this investment, the \$50,000 investment should become \$5,000,000 on a pro forma balance sheet.

Patents are frequently carried at a nominal value of \$1, yet the mere existence of these patents may be the primary reason the acquiring company is seeking to make the acquisition. The purchaser should place some fair value on these patents when he evaluates the financial statements.

### *Land may be more valuable*

In this period of rising land values and explosive suburban growth, it is not uncommon for a company suddenly to find that unused excess acreage, which it bought 50 years ago along with its

factory site, has substantial value as development land. Appropriate present-day values should be assigned to this acreage.

Close examination of the fixed assets could reveal some factory buildings in a depressed industrial area being carried at cost less normal depreciation. Present-day value for such property might be only a fraction of the book value. Often in such areas operating income from such a branch factory is marginal, and new management may expect to close it down. If so, the value for this property should be written down to the realizable value.

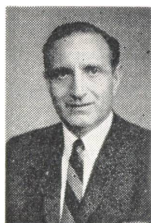
In general, undervalued and overvalued assets should be fully disclosed and treated appropriately. Unrecorded assets and liabilities should be ferreted out and presented in the accountant's specially prepared reconstructed report of financial condition.

Every effort should be made to discover and reflect contingent liabilities. Care should be exercised to determine whether there exist any circumstances that would create a new liability as a result of contemplated action after the merger. For example, if plans call for closing down a branch factory after merger, will liabilities be created under the union contract or under employment contracts as the result of layoffs?

### *Special factors*

Frequently the purpose of the acquisition determines which items require special attention. If the CPA has been informed that the principal purpose of the merger is for the purchaser to utilize excess working capital of the seller more productively, special analysis should be made of the current asset and current liability sections of the acquired company's balance sheet.

If the apparent excess of working capital is in cash, the cash may in fact be distributed among dozens of bank accounts around the country for the use of the branches of the company. In this event,



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there probably would not be any surplus of cash actually available for siphoning off; such cash would have to remain relatively fixed as working capital just as it had always been.

Similarly, on first examination accounts receivable and inventories may appear to be unnecessarily high in relation to the volume of business and therefore subject to substantial liquidation. Further analysis could reveal, however, that the nature of the industry requires long credit terms and completely stocked warehouses in many locations ready for prompt delivery to customers.

### Effects of merger

In the preparation of the reconstructed pro forma income statement provision has to be made in most cases for substantial changes in the depreciation and amortization charges. Sales should be analyzed to determine whether competitors of the acquiring company are among the selling company's customers. Such outlets would probably be lost after the merger, and provision should be made for an appropriate reduction in forecasted sales.

Sometimes the company being acquired has been so limited in working capital that it has had to forego significant quantity discounts in its purchases. If the merger will bring in adequate financing, then the savings through quantity raw material purchases may be reflected in the pro forma income statement.

If the purchaser has good distribution facilities, and the products of the new company are sufficiently compatible to be sold through the same sales channels, then consideration should be given to the anticipated increased sales and/or lowered distribution costs.

Included in the CPA's full pro forma report on the financial condition of the proposed acquisition should be a cash flow statement as well as significant ratios. These ratios may include all the normal

financial ratios submitted in a long-form report, but they should also include many ratios and computations not as familiar to the average accountant. These are the ratios and computations that are commonly used by investment bankers. Items such as "Net Quick," "Market Capital," and "Sales to Common Stock Equity" are meaningful and could be significant in an acquisition analysis.<sup>1</sup>

Without making a conventional audit, the CPA consultant must satisfy himself that he understands the composition of all material items he proposes to include in the pro forma statements. This he does by examining documents made available to him and by conversations with key executives.

The figures in the completed pro forma statements must be *fairly stated in relation to the going concern value in the hands of the purchaser*. The fact that the original statements of the company were regularly audited by a CPA firm does not obviate the need for this recasting of all figures, largely because figures presented in accordance with "generally accepted accounting principles" do not necessarily represent fair present-day values.

After the pro forma report is completed and submitted to the client, the CPA may be called upon

<sup>1</sup> The book *Security Analysis* by Benjamin Graham, David L. Dodd, and Sidney Cottle (Fourth Edition, McGraw-Hill Book Company, New York, 1962) gives excellent definitions and examples of applications of these and other ratios.

to advise the negotiators. Here the resourceful accountant can be invaluable to his client by bringing into play his background in taxes, SEC regulations, and corporation finance as well as his own business acumen. At this stage the CPA also would be consulted on whether the acquisition should be a "pooling of interest" or "purchase."

After terms are agreed to and the legal merger takes effect, there then open up two other areas of substantial service by the CPA.

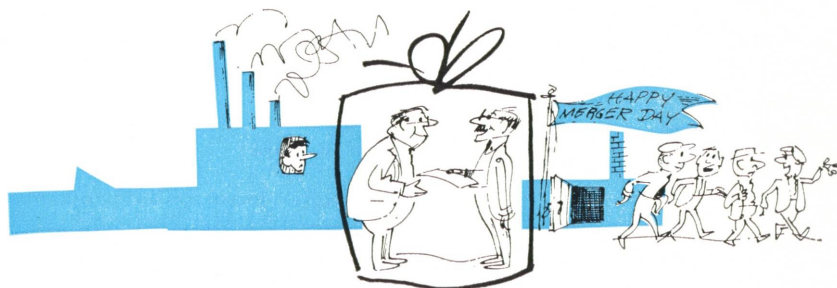
### Audit of acquisition

The immediate area is an audit of the newly acquired company. This may be a conventional audit, with especial emphasis on items that may have given rise to questioning during the negotiations. Frequently certain items of a merger agreement are left open pending a determination of values by just such an audit. There is no need to elaborate on the service performed at this stage since it is done in accordance with generally accepted audit standards.

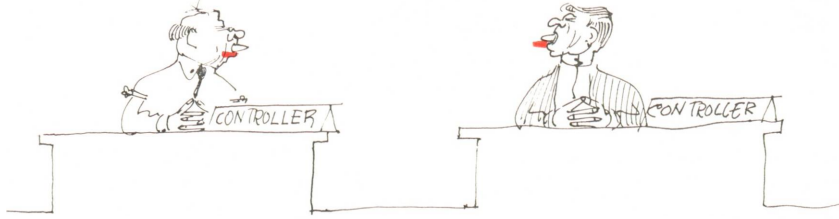
The final role played by the CPA consultant could be the most significant and lasting.

### Integration

In a takeover control is first exercised over the acquired company through financial supervision and required reporting of economic data. This means that immediately after the legal merger has been effected, new reporting procedures must be developed, and the organi-



"Going concern" values are valid only if the acquiring company is sure the personnel of the acquired company will stay on the job.



Jealousies and antagonisms between opposite numbers in the merged companies are to be avoided at all costs. Make sure all sides know who is boss.

zational structure of the accounting and administrative departments may have to be modified. This is the beginning of the long and sometimes explosive integration process. Yet if the merger is to work out successfully, harmony and cooperation among all personnel are essential.

The acquiring company has negotiated for and purchased "going concern" values. Such values are valid only if the acquisition includes an organization of people, for people, not figures, are the key to going concerns. Everything possible must be done to prevent the appearance of disruptive factors. As Myles L. Mace expresses it, "Each organization that a company acquires is made up of a unique combination of human and physical assets, and it is the job of the acquiring company management to motivate and administer this unique group so as to achieve the objective which made the arrangement appear to be a good one in the first place. Preoccupation with financial angles of a merger deal often results in a failure to plan for the maintenance or strengthening of the going concern value of the acquisition."<sup>2</sup>

Because of the CPA's training and unique background in dealing objectively with many types of people in various administrative

set-ups, he is in an excellent position to render invaluable service as an advisor all during the integration process.

### Organization

As a starting point, organization charts of the accounting and administrative departments for both the acquired company and the acquiring company should be prepared. These charts should indicate by name the person currently occupying each position. Biographical sketches and performance records for each of these people should also be available for study.

At the same time paperwork flow charts should be prepared that set forth procedures currently in effect. With this material on hand, a careful evaluation of the best personnel and systems in each company can be made. This work may be executed by a committee composed of the administrative head of each company and the consulting CPA. Out of this study should evolve the framework for integrating the accounting and administrative functions, including a revision of paperwork procedures where necessary and a clarification of organizational relationships.

### Who is boss?

Organizational relationships must be clarified early to avoid misunderstandings and disruptive attitudes. This clarification should cover such basic points as where each person's responsibility begins and ends under the merged set-up;

what reports are to be submitted and to whom, and who is superior to whom.

What to do with excess supervisory manpower when functions are combined is always an important consideration. Such questions as these must be answered: Which chief accountant is chief, and which controller is boss? Possible benefits of a merger are quickly lost if key personnel stop doing their best or if the executive payroll goes up because the headquarters office decides to hire top financial or administrative executives to sit above the chief financial or administrative officers of the merged companies. The CPA advisor can materially assist management by pointing up these human relations elements in a merger.

So these are some of the things that must be done: a hard look at current values and assets of the company being acquired; evaluation of the effect the acquirer's resources would have on it; some insurance that its personnel will stand by.

No matter how pretty and comprehensive the elaborate pro forma financial statements may appear when presented to top executives, no financial merger can really be considered consummated until there is organizational merger. Postponing this integration in the hope that matters will work out by themselves as the members of each group of executives get to know one another better can be, and often is, disastrous. By constructive, mutually accomplished integration, new systems and machines may be explored, needless paperwork can be eliminated, and a progressive atmosphere may evolve in the entire administrative area.

A word of caution. If, after study, it appears that nothing can be gained by unifying the systems, then let things remain as they are. We should not concern ourselves with building neat, uniform organizational and flow charts as an end in itself. Our objective must always be efficient, harmonious integration in a manner which will permit effective control.

<sup>2</sup> "Mergers and Incentives" by Myles L. Mace, Harvard Business School, in *Incentives for Executives*, edited by David W. Ewing and Dan H. Fenn, Jr., McGraw-Hill Book Company, New York, 1962.

*Short-term investment of idle corporate cash can pay off very well, if four major criteria are kept in balance. Here is a mathematical pointing system to aid management in finding a safe and profitable program —*

## THE INVESTMENT OF CORPORATE CASH

*by Edward J. Mock*

*The George Washington University*

**I**N RECENT years the investment of corporate cash in the money market has become an important part of the financial manager's responsibility. The new attention to profitable short-term investment is part of a growing emphasis on increasing the velocity of corporate funds. The reasons for this trend (chiefly the increased availability of cash because of high depreciation charges and the rising level of interest rates, which makes it more costly to hold idle cash) and

some of the ways of conserving and making better use of cash were discussed in detail in an earlier issue of *MANAGEMENT SERVICES*.<sup>1</sup>

The financial managers of corporations that have large amounts of surplus cash are responsible for putting it to work at a high yield while at the same time keeping it

secure. This is a highly skilled task. Today's money market offers a wide range of temporary securities from which the financial manager may choose, and they vary widely in risk and return. The purpose of this article is to examine the characteristics of the major available investment alternatives in relation to corporate policy and to suggest a mathematical pointing system that holds safety, liquidity, length of maturity, and yield in balance.

<sup>1</sup>See "Increasing the Velocity of Corporate Cash" by Edward J. Mock and Donald H. Shuckett, *M/S*, July-August, 1966, p. 39.



The short-term securities in which corporations most commonly invest are listed in Exhibit 1 on page 55. In selecting among them the financial manager must evaluate them in terms of those same four principal criteria: safety of principal, the liquidity or marketability of the security, maturity, and yield.

### ***Safety first consideration***

It is essential to ensure the safety of corporate funds. To do so, many financial managers restrict themselves to marketable investments that remain relatively stable in price. Thus they minimize the risk of capital loss if liquidation should become necessary.

Another important ingredient of safety is the financial stability of the organization sponsoring the security. Securities guaranteed by the United States government or issued by a government agency are considered the safest. The degree of safety of commercial paper, finance company paper, and certificates of deposit depends to a large extent on the size and reputation of the issuing corporation or bank.

Since surplus cash is available primarily for short-term investment, liquidity is a major consideration. It should be possible, in case of need, for financial managers to convert the investments into cash on short notice.

Short maturities are also preferred since most companies intend to use the invested cash in the near future for receivables, inventory, or other payments—or want

to have it reasonably available as a hedge against the unexpected. If the cash invested is earmarked for specific payments, such as dividends or taxes, it is desirable to acquire a flexible security with maturity dates chosen to coincide with the date of the cash disbursement.

The final objective of short-term corporate investment, of course, is to maximize yield. Minute variations in yield can be significant when large sums of money are involved; for a corporation with excess cash of \$25 million, for example, an increase of only one basis point (0.01 per cent) can have a major impact. To obtain higher yields within the limits of safety and corporate policy requires careful selection of securities.

### ***Weighting investment factors***

To evaluate a security in terms of these four criteria, safety, liquidity, maturity, and yield, a company might develop a model such as that illustrated in Exhibit 2 on page 56. This model is essentially a point system for ranking the securities by weighted factors for the four criteria.

Each of the four investment criteria is given an arbitrary value of one to four. The most important criterion, safety, is given the highest factor value, 4; the least important criterion, yield, is given the lowest factor value, 1. Then the principal types of money market securities are listed and ranked in relation to each other. The rank of 1 represents the greatest risk and the least return. Finally the security's rank is multiplied by each of its factor values to obtain a tabulation of weighted security-factor values. The total of the weighted values represents the relative strength of each security. The higher the total number the stronger the security.

The ranking of the securities depends on the current yield rates and the extent to which the securities meet the other investment criteria. To arrive at the values in

***Each of the four investment criteria (safety, liquidity, length of maturity, and yield) is assigned an arbitrary value. The most important criterion, safety, is given the highest factor value, 4; the least important, yield, is given the lowest factor value, 1. Then the principal types of money market securities are listed and ranked in relation to each other.***



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Securities	Comments
Treasury Bills 91-day maturity, issued weekly	These are the most popular investment since they combine security (as obligations of the U. S. government) with liquidity (because of the frequency and regularity of their issuance).
U. S. Treasury Notes, Certificates of Indebtedness, and Tax Anticipation Certificates More than 91-day but less than five-year maturities	Also popular, these are useful for companies that wish to invest to meet specific cash requirements (dividends, taxes, and capital expenditures).
Federal Agency Securities Offerings of five federally sponsored credit agencies (federal land banks, banks for cooperatives, federal home loan banks, federal intermediate credit banks, Federal National Mortgage Association) that issue their own securities and borrow directly from the public Most corporate portfolios are restricted to nine-month to one-and-a-half-year maturities	These securities are not guaranteed by the federal government, and their yield is generally just above that of Treasury securities. However, they are considered very safe investments.
Public Housing Authority Notes Issued to finance various government land development projects Most corporate portfolios are restricted to one-year maturities	These securities have the double advantage of being guaranteed by the federal government and of being tax-exempt. The latter feature makes the effective yield to a corporation roughly double that quoted. The strong demand for these notes makes them very liquid in the secondary market.
State and Local Bonds One-year and longer maturities (A number of states will provide almost any maturity required by a corporate buyer.)	Those rated AA and AAA are considered very safe investments. Their tax-exempt status makes them the highest-yielding security in the money market. They are sometimes used to meet specific cash requirements.
Bankers' Acceptances One-month to six-month maturities (usually three months)	A bankers' acceptance is a time draft, drawn on a large bank by a trader, that becomes a negotiable instrument and can be discounted for resale to investors. It is considered a very safe investment.
Time Certificates of Deposit (CD's) Activity is generally restricted to prime certificates with a maximum maturity of 90 days. However, maturities of up to a year are available.	The CD is a receipt given by a bank for a time deposit of money. The bank promises to return the amount deposited plus interest to the bearer of the certificate on the date specified. The certificate is transferable and may be traded before its maturity date. The current maximum rate for certificates over \$100,000 is 5½%; under \$100,000, 5%. Market rates for prime certificates are often ¼% higher than rates for Treasury bills of comparable maturity. Because the denominations offered are large and Federal Deposit Insurance Corporation protection is limited to \$10,000, the size and reputation of the issuing bank are important.
Finance Company Paper Short-term maturity, usually 90 days (A number of finance companies will provide almost any maturity required by the corporate buyer.)	These obligations of companies financing consumer appliances and automobiles are reasonably safe, but much depends upon the reputation of the issuing company. They are traded on the secondary market, and maturity dates are usually very flexible. Yield is generally high.
Commercial Paper Usually four-month to six-month maturities but sometimes as short as five days (Purchasers usually intend to hold such obligations until maturity.)	Commercial paper today consists mainly of short-term, unsecured promissory notes issued by a relatively small group of highly rated companies. The yield is usually the highest of those that can be obtained from any short-term security except tax-exempts.

## EXHIBIT I

the example the yield rates for October, 1966, were used. The length of the maturity was evaluated by giving the shorter maturities the higher value. To evaluate liquidity and safety the considerations mentioned earlier in the article were used. The model developed here would be useful until yield rates fluctuated significantly or until a

new type of money market instrument were offered.

The actual selection of a complete investment portfolio also requires consideration of the corporation's basic investment policy. The financial manager must determine what percentage of the portfolio each type of security should represent.

A way of comparing the total yields from portfolios of varying composition is shown in Exhibit 3 on page 57. In this matrix of alternative portfolios<sup>2</sup> the percentage

<sup>2</sup>Adapted from *Money-Market Investments: The Risk and the Return*, Morgan Guaranty Trust Company of New York, New York, 1964, page 56, Table 4.

**If a company were investing \$20,000,000 annually in the money market . . .**

Relative Value of Securities as Related to Risk and Return Factors					
	Security's Relation to Factor				Adjusted Yield
	Safety	Liquidity	Maturity		
Treasury Bills	7	9	7	1	5.22%
U. S. Treasury Notes	6	8	1	2	5.36
Federal Agency Securities (FHLB)	3	6	2	4	5.55
PHA Notes	5	7	4	8	6.66*
State and Local Bonds (tax-free)	4	5	3	9	7.50*
Bankers' Acceptances*	2	2	7	5	5.65
Time Certificates of Deposit	2	4	6	3	5.45
90-day Finance-Company Paper	1	1	7	6	5.88
Commercial Paper	2	3	5	7	6.00

\*adjusted to before tax for comparison purposes

TIMES (X)	
Value of Factor	
Safety	4
Liquidity	3
Length of Maturity	2
Adjusted (before tax) Yield	1

EQUALS (=)						
Weighted Security-Factor Values						
	Safety	Liquidity	Maturity	Yield	Total	Rank
Treasury Bills	28	27	14	1	70	1
Treasury Notes	24	24	2	2	52	3
Federal Agency	12	18	4	4	38	5
PHA Notes	20	21	8	8	57	2
State Bonds	16	15	6	9	46	4
Bankers' Acceptances	8	6	14	5	33	8
Certificates of Deposit	8	12	12	3	35	6
Finance-Company Paper	4	3	14	6	27	9
Commercial Paper	8	9	10	7	34	7

**EXHIBIT 2**

of the composition of a given investment portfolio that a specific investment medium makes up is multiplied by the applicable yield to derive the weighted yield factor for that investment medium in that investment program. The weighted portfolio return for a given investment program is determined by summing the weighted yield factors.

**Time base of matrix**

In the matrix presented as an example the yield rates on U. S. Treasury bills, commercial paper, Federal Home Loan Bank bonds, bankers' acceptances, 90-day finance company paper, certificates of deposit, and Treasury notes represent

the highs for October, 1966. The yield on tax-exempt securities is the adjusted pretax average yield on Public Housing Authority notes and state and municipal bonds for October, 1966.

**Portfolio policies**

The eight investment programs presented can be used to demonstrate the corporate investment policies and decisions behind the percentage composition of the portfolios. Programs A and B represent conservative portfolios for a company mainly concerned with security of principal. This company maintains primary reserves in the form of Treasury bills and notes to provide funds for unforeseen dis-

bursements on short notice or to meet unexpected variations in operating cash requirements.

Programs C and D are still conservative, with 40 per cent of the funds in Treasury bills and notes, but they strike more of a balance between short- and longer-maturity investments, thus increasing the yield. A company could invest 40 per cent in certificates of deposit, Federal Home Loan Bank bonds, Public Housing Authority notes, and tax-exempt securities for the primary purpose of meeting a particular predictable future cash need, e.g., dividends or plant expansion. Such securities are purchased to mature on or near the date of the cash need. This avoids the liquidity risk.

... there would be a difference of \$185,400 in interest earned between Programs A and H.

Matrix of Alternative Portfolios										
Program	Percentage Composition of Portfolio								Yields	
	TB	TN	CD	FHLB	BA	CP	PHA	TE		
A	30%	30	10	10	5	5	5	5%	TB	5.22%
B	25	25	10	10	10	5	10	5	TN	5.36
C	20	20	10	10	10	10	10	10	CD	5.45
D	20	15	10	10	10	10	15	10	FHLB	5.55
E	15	10	5	10	10	20	15	15	BA	5.65
F	10	10	10	10	10	10	20	20	CP	6.0
G	10	5	5	10	10	10	25	25	PHA	6.66
H	5	5	5	5	10	10	30	30	TE	7.50%

Program	Weighted Yield Factors								Weighted Returns on Portfolio	
	TB	TN	CD	FHLB	BA	CP	PHA	TE		
A	1.566%	1.608	.545	.555	.282	.3	.333	.375%		5.564%
B	1.305	1.34	.545	.555	.565	.3	.666	.375		5.651
C	1.044	1.072	.545	.555	.565	.6	.666	.750		5.797
D	1.044	.804	.545	.555	.565	.6	.999	.750	EQUALS	5.862
E	.783	.536	.272	.555	.565	1.2	.999	1.125	(=)	6.035
F	.522	.536	.545	.555	.565	.6	1.332	1.5		6.155
G	.522	.268	.272	.555	.565	.6	1.665	1.875		6.322
H	.261	.268	.272	.277	.565	.6	1.998	2.25		6.491%

Notes to Table

- TB: 91-day U. S. Treasury Bills
- TN: U. S. Treasury Notes
- CD: Negotiable Time Certificates of Deposit
- FHLB: Federal Home Loan Bank Bonds
- BA: Bankers' Acceptances
- CP: Commercial Paper
- FHA: Public Housing Authority Bonds
- TE: Tax-Exempt Securities

Adapted, with permission, from *Money-Market Investments The Risks and the Return*, copyright 1964 by Morgan Guaranty Trust Company of New York, New York, page 56, Table 4.

### EXHIBIT 3

The emphasis in Programs E and F is on medium-term maturity dates, with 40 per cent invested in bankers' acceptances, Federal Home Loan Bank bonds, and commercial paper. This portfolio carries somewhat greater risk and therefore higher returns. Forty per cent of the portfolio is in Public Housing Authority bonds and tax-exempt securities. A company with such a portfolio usually can predict its operating cash requirements with considerable reliability.

Programs G and H are the most dynamic. They are well balanced between medium-term and long-term maturities. Moreover, they provide for a short- and medium-range safety factor in the form of Treasury bills, notes, and negotia-

ble certificates of deposit. Primary emphasis is on Public Housing Authority and tax-exempt securities, which produce the highest yields; 60 per cent of the portfolio is invested in these securities.

#### Possibilities of profit

The impact of increasing the return on an investment portfolio by a fraction of a per cent is clear from the following calculation: A basis point (0.01 per cent) of yield has a value of \$1,000 per \$1,000,000 invested each year. This means that if a company were investing \$20,000,000 annually in the money market, there would be a difference of \$185,400 in interest earned each year between Pro-

grams A and H, as presented in the matrix decision model. This might be enough to compensate for the higher risk of Program H. It might also be sufficient to pay the salary of a good portfolio manager and his staff.

The financial manager of a company with large amounts of excess cash to invest must utilize the available investment media skillfully to obtain high yields. By using the two analytical techniques presented in this article, he can evaluate his alternatives in terms of the basic investment criteria and of basic corporate policy. With this information as a tool, he should be able to increase the return on his total portfolio without undue sacrifice of security.

## what people are writing about

### BOOKS

**Financial Analysis to Guide Capital Expenditure Decisions** (Research Report 43), National Association of Accountants, New York, 1967, 193 pages, \$2.50.

*Despite its designation as a research report, this paperback volume is intended to summarize existing knowledge rather than to break new ground. The result is a thoroughly up-to-date working guide to the entire capital budgeting and capital expenditure control process.*

The various aspects of capital expenditure decision making are among the most popular topics in management magazines and academic journals. No businessman could be blamed for feeling that the subject has been done to death. Why another book about capital budgeting?

The answer is that there has been substantial progress in this field in recent years—and not only in the development of theories. As this book, partly based on a survey of practice in progressive corporations, shows, companies are actually using techniques like sensitivity analysis and simulation.

Here is a comprehensive report

on the state of the art. In addition to such well worked over areas as the various methods of evaluating the return from proposed projects and lease-purchase analysis, it covers long- and short-range planning, determination of the size of the capital budget, administrative procedures in capital budgeting, project control, and post-completion audits.

A chapter on “modern” analytical techniques takes up sensitivity analysis, risk analysis, simulation, linear programming, CPM and PERT, and some computer program models available from equipment manufacturers. Thirty-six exhibits illustrate the application of the various

### REVIEW EDITORS

In order to assure comprehensive coverage of magazine articles dealing with management subjects, MANAGEMENT SERVICES has arranged with fifteen universities offering the Ph.D. degree in accounting to have leading magazines in the field reviewed on a continuing basis by Ph.D. candidates under the guidance of the educators listed, who serve as the review board for this department of MANAGEMENT SERVICES. Unsigned reviews have been written by members of the magazine's staff.

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WILLARD E. STONE, *University of Florida, Gainesville*

RUFUS WIXON, *University of Pennsylvania, Philadelphia*

techniques. In most cases the methods are described in sufficient detail to permit their use with little if any reference to additional sources.

Even the financial man who has kept up with this field should find this volume useful.

**Incentives in Manufacturing: Individual and Plantwide**, by R. C. SCOTT, Vols. 1 and 2, The Eddy-Rucker-Nickels Company (4 Brattle Street, Harvard Square, Cambridge, Mass. 02138), 1966 and 1967, 32 and 47 pages, respectively, \$1 each.

*These pamphlets, basically promotion pieces for the sort of incentive program the author's firm installs, provide a biased but informative description of group incentive programs.*

Despite the subtitle, little attention is given to individual incentive plans in these booklets, reprints of a series of articles first published in *Circuits Manufacturing* magazine. The emphasis is on the costs and weaknesses of incentive plans for individuals, not on procedures.

Profit sharing and other types of plantwide incentives get a more thorough discussion. The author tells how to install and maintain them, with case examples, and warns against possible pitfalls. The reader who keeps in mind that the author has an axe to grind—and makes the appropriate mental adjustments—will find these pamphlets useful background material.

**Understanding Computers** by THOMAS H. CROWLEY, McGraw-Hill Book Company, New York, 1967, 142 pages, \$2.45 paperback, \$4.95 hard cover.

*This layman's guide to the computer is a first-class job of simplification.*

Among the dozens of books that seek to bring the computer down to the level of the common man this may well be the best.

Based on an adult education course the author taught to housewives, this book is pitched to the high school level in style and in the background assumed. It requires no knowledge of mathematics beyond simple arithmetic and no understanding of physics or engineering.

It is difficult to explain what a computer is and how it operates within these limitations, but Mr. Crowley has done it. Unlike most writers on this subject, he does not get bogged down in the details of electronic gadgetry. He concentrates on the basic concepts behind the computer—symbols and their manipulation—and manages to make them crystal clear.

This is not really a businessman's book. The author (who directs the Computing Science Research Center at Bell Telephone Laboratories) is interested in the machine not the data processing function, and his discussion of applications is skimpy. Read in conjunction with a more business-oriented popularization, however, this book is a splendid introduction to computers.

**Computers and Small Manufacturers** by ALEXANDER M. BLANTON, JOSEPH TRAUT, and ASSOCIATES, Computer Research & Publications Associates (P.O. Box 480, Lenox Hill Station, 217 East 70th Street, New York, N.Y., 10021), 159 pages, \$17.50.

*A survey of small manufacturers' experience with computers is combined with standard information about electronic data processing.*

This volume, a book-length term paper prepared by a group of Harvard Business School students, is described by its authors as the "first major study of computer use in the operations of small manufacturing companies." Its chief,

though unstated, finding appears to be that computer use in small manufacturing companies does not differ greatly from that in larger ones.

The authors surveyed a number of small manufacturers in the Boston area that use computers. The results of this survey, while not startling (i.e., the ability to perform operations that were previously impractical was the most important benefit of the computer), were well worth reporting. Particularly interesting are the cost data and the case study applications.

The rest of the book, drawn largely from secondary sources, follows the usual feasibility study, installation, service center, etc., outline. These authors had enough original material for a good magazine article; the book as a whole treads too much familiar ground to be worth the investment.

### **Briefly Listed**

**Glossary of Management Techniques** by Her Majesty's Treasury, Her Majesty's Stationery Office, London, 1967, 26 pages, \$.55.

This booklet lists some sixty of "the principal techniques, particularly those in the management accounting field, which are available as aids to efficient and economical management." The terms are defined, in some cases with some how-to-do-it information, and references are supplied, with the aim of indicating "to the layman whether a particular problem with which he has to deal might be a suitable candidate for the application of a particular technique."

**Selected References on Management Consultation**, Association of Consulting Management Engineers, Inc., New York, 1967, 23 pages, \$1.

This bibliography, prepared annually by the ACME staff, lists books, pamphlets, papers, proceed-

ings, and these on management Magazine of Planning, Systems, and Controls, Vol. 4 [1967], No. 5, and those staff and management consulting that might be helpful to consultants.

## MAGAZINES

**Computer Time-Sharing—Everyman at the Console** by JEREMY MAIN, *Fortune*, August, 1967.

*This report on the current status of time sharing makes it clear that the technique's real impact is yet to come.*

Time sharing, the programing of a computer so that it can serve many users simultaneously, is the most exciting current development in electronic data processing. This article reviews the rather limited progress to date and attempts to forecast the future.

Ultimately time sharing is likely to be the basis of the much discussed computer utility. There are problems, however. With large-scale systems there is risk that the computer will have to spend more time administering its programs than actually computing. With multiple users communications costs become crucial—and the relationship between the computer industry and the communications industry is currently in a state of confusion.

As a journalistic attempt to illuminate a complex subject, this article is not up to *Fortune's* usual standard. The author has not done his basic homework thoroughly—or at least has failed to share the results completely with the reader.

His conclusions are provocative, but they are overhung by a general air of fuzziness. The basic terms are not clearly defined; the author fails to differentiate among such terms as on line, real time, and time sharing. Although he lists a few of the current users of time sharing—and provides a handy tabulation of those offering the service—he never attempts to delineate the kinds of computer time users who actually need interaction

Thus, this article, which probably offers no information new to the computer specialists, is really intelligible only to them. The businessman who would like to know what time sharing is and what it can do for him will find no help here.

**Do Management Control Systems Achieve Their Purpose?** by DOUGLAS MCGREGOR, *Management Review*, February, 1967.

*This article was adapted from the unpublished writings of the late Douglas McGregor. A number of these writings have been collected into a book, "The Professional Manager," edited by Warren G. Bennis (McGraw-Hill Book Company, Inc., New York, 1967). The central theme of this article is that conventional control systems have a strong tendency to generate and accentuate the very behavior they seek to prevent: noncompliance.*

The prime objective of management has always been to get employees to function at high levels of performance. In the conventional control system this is accomplished by informing individuals of how they measure up to managerial standards through a built-in feedback system of extrinsic rewards and punishments.

### Threats

Control systems often fail, however, according to Dr. McGregor, because designers do not understand that "noncompliance" tends to appear in the presence of "perceived threat" and that heavy reliance upon external controls over human behavior causes these controls to be viewed as threatening by those affected by them. Conditions under which a threat is likely to be perceived include the following: (1) pressure for compliance with externally imposed standards, (2) lack of trust and support be-

### Noncompliance

If these conditions are present, specific forms of noncompliance can be predicted: (1) simple failure to comply with demands for change, (2) the exercise of human ingenuity to defeat the purposes of the control system, and (3) dishonest behavior justified and rationalized by the presence of threat.

The mere absence of threat does not guarantee compliance, however; it may simply lead to indifference or a reduction in active noncompliance. Absence of perceived threat is a necessary but insufficient requirement for positive compliance. The basic requirement is identification and commitment based on a linking of the individual's own goals with those of the organization. Only through open communication, mutual trust and support, and management of conflict by "working it through" can employee commitment to goals and standards be achieved.

### 'Organic' control

Dr. McGregor describes such a system as an "organic control system." Emphasis is placed on intrinsic rewards and punishments and on strengthening the commitment of members to organization goals. The selection of data to be distributed evolves from the needs of individuals, and the information is gathered and transmitted to them under conditions of trust and openness. Surveillance in the usual sense is largely unnecessary. The author cites several examples of this type of control system and reports results of better performance and compliance.

Dr. McGregor suggests that the transition to this type of control

system should be an evolutionary process. Unquestionably many accountants would view an organic control system with suspicion, fearing that it would result in a complete absence of controls. Accountants, however, can no longer ignore the growing volume of literature on the behavioral implications of our control systems. If, in their desire to control the deviant, they are laying the foundations of deviance, then there is need for a critical review of the purposes and objectives of management control systems. This article—and probably the entire book—should be seriously considered by every accountant involved in management control systems.

ROBERT J. SWIERINGA  
*University of Illinois*

**A Career in Business Accounting**  
by LYNN A. TOWNSEND, *The Accounting Review*, January, 1967.

*As accounting blossoms into the critically important rose of the complex business organization, ever-widening opportunities are arising for the competent, imaginative professional. Today's sought-after accountant is business-oriented, thinks on an international plane, has acquired interdisciplinary knowledge, and refuses to "get lost."*

The multi-national character of today's business enterprise requires the modern business manager to respond to the political constituency of the stockholders. Because of this broad scope of influence he needs accountants, for example, who view the world as a product of its component parts rather than as one large whole to be exploited, dominated, or avoided. Mr. Townsend believes that now as never before the requirement for team thinking and group development is upon us. The accountant is being called on by business to assist it in maintaining the economic health and strength of the nation and to plan the new jobs, new investments,

and new growth opportunities that are required to keep our country, and all countries of the world, moving ahead.

### **Quiet revolution**

The "quiet revolution"—business—is the most potent force in the world today, according to the author and is accomplishing remarkable things in the social as well as the economic area. Our modern system of private international business organizations is undertaking the exploration of all of the possibilities of the world's economic future, individually and separately, and yet with extensive exchange of gained knowledge. Additionally, plans are continually laid to make that future happen—happen to the ultimate benefit of mankind.

Mr. Townsend concludes that one of the reasons for the remarkable success of the "quiet revolution" is the occurrence of double benefits attending the solving of business problems. The development of a skilled work force to man a new industrial installation provides thousands of people with the opportunity of finding new dignity in creative and responsible positions. There is need to advertise more actively to young people that business is not interested solely in profits, that it feels a great social responsibility and that it does something about it. Private business provides youth with a more concrete means of expressing idealism.

### **Misconceptions**

Why deleterious stereotypes of big business evils cling so tightly admittedly eludes the author. Probably the prominence accorded by the press to antisocial activities of some businessmen, combined with the miniscule reports of the desirable activities of most businessmen, tends to continue and even to reinforce these misconceptions. Another factor is that most books written about business prefer to attack rather than to praise, obscuring the fact that our business system is one

of the modern wonders of the world. All accountants must assume the responsibility of informing others about our business institutions to help them understand the incredible gathering together of varied talents and the direction of their combined efforts toward a common purpose that take place in the modern corporation.

According to the author, it is also a great mistake to view the modern accountant as the bright and highly trained watchdog he was thirty years ago, hired to protect stockholders' interests and to inspire the confidence of bank and government. Today the business accountant is still a custodian, but custodian of the profit mechanism that guides and controls our entire free enterprise system. He is a strategist and a planner, studying the trends of profitability in all subsystems of the overall system designated as the corporate enterprise to spot signs of strength and weakness. He not only reports these signs but develops corrective or exploitive measures and many times assists in their implementation. Keeping a company on a profitable course, filling a public need in the face of upward cost pressures and downward price pressures, is one of the great challenges of our time. And the business accountant has the job of meeting that challenge.

### **Opportunities**

Mr. Townsend's remarks gain stature from his background of having successfully approached business problems both as an independent consultant and as an operating manager. His opinions on the informational responsibilities of professional accountants and business educators are therefore noteworthy. And his message is important. The broad and varied opportunities afforded by modern business need to be expounded to the student along with business examples of the power of group dynamics. Individual fulfillment can more easily be obtained by working with others than alone.



Anyone who has known services, a Magazine of Planning, Systems, and Controls, Vol. 4 (1971), No. 5, p. 11. The base period for the moving average method was varied among 6, 12, 18, 24, and 36 periods.

Mr. Kirby was able to use 23 time series of actual sales data of the Singer Company. Each one consisted of 7½ years of monthly sales data. In addition, in an effort to examine time series dominated by various characteristics, 30 synthetic series were constructed by the author.

Modern enterprises do not cramp the style of the employee; on the contrary, they provide the most fertile ground available for the development of his individuality and creativity. Change is the life blood of our business system, and the opportunity to make improving changes pervades every facet of this dynamic vehicle of economic progress.

Drawing from the experience of Chrysler Motors Corporation, the author describes various instances of social improvement that resulted from the establishment of new plants, both domestic and foreign. These improvements include such items as the training of skilled workers, the improvement of living conditions, and the schooling of the children of workers in Colombia. In total, in 1964, foreign investment by business more than doubled that sent overseas in economic aid. At the same time many firms, including Chrysler, have for years returned more money to the United States each year than they sent abroad, thus improving the balance of payments situation.

### **Danger**

John W. Gardner, Secretary of Health, Education and Welfare, is quoted as pointing out that many people, especially in our universities, hesitate to work toward leadership positions. While they vigorously uphold the right to advise and to criticize the leader, few want to be the leader, either in business or in government. Abdication of

gerous attitude in educators, for they may well be drying up the supply of future leaders. Business provides an opportunity for the development of the leadership our society needs, but the need must be recognized by those influencing these citizens of tomorrow.

Business, with its facility for change and progress and the "double benefits" that emerge from solutions to business problems, is a social force for good unequalled anywhere in the world. Our business system's future success may depend on how well we communicate this message to others. The greater the understanding of the social contributions of business the more productive the businessman's job will be. Business needs the help of the young accountants and comptrollers of tomorrow, and these young people need our help and our counsel today.

MAX T. CORNWELL, CPA  
*University of Southern California*

**A Comparison of Short and Medium Range Statistical Forecasting Methods** by ROBERT M. KIRBY, *Management Science*, December, 1966.

*In this article Mr. Kirby analyzes the accuracy of several forecasting methods based upon 23 actual time series and finds that for pure trend series, all methods could be equally accurate; for trend-dominated series, either exponential smoothing or moving average could be better; and for cyclical data, exponential smoothing is usually the best.*

The forecasting accuracy of three frequently used forecasting methods, exponential smoothing, moving average, and least squares, was tested. The methods were tested for forecasts of one period and six periods with times series having various characteristics such as strong trend or cyclical factors. Also, the parameters were varied to test the effect on forecasting ac-

curacy. For example, the base period for the moving average method was varied among 6, 12, 18, 24, and 36 periods.

The first three years of data were used to determine seasonal and trend factors in the 23 actual time series. The remaining four years were used to test the forecasting accuracy of the three forecasting methods. The criterion used to judge forecasting accuracy was the average absolute forecast error.

Several conclusions were reached from analysis of the forecasts based on the 23 actual time series. First, the exponential smoothing and moving average methods were generally superior to the least squares method. Second, the exponential smoothing and moving average methods were about equally accurate for intermediate forecasts (six months). Finally, the exponential smoothing method was slightly better than the moving average method for forecasts of one month.

By creating series dominated by trend, cyclical, or "caused noise" factors, the author was able to make some other general statements about the accuracy of the three methods. For pure trend series, all of the methods could be equally accurate if the proper parameter values were chosen. For trend-dominated series, either exponential smoothing or moving average was better, depending on the choice of parameter values. For cyclical data, the exponential smoothing method was generally the most accurate method.

By "caused noise" Mr. Kirby means short, cyclical, and irregular fluctuations in times series, which may be caused by such events as advertising campaigns or quality control problems. In analyzing the synthetic time series dominated by

"caused noise," the moving-average method was found to be the superior method.

Planners and others interested in forecasting techniques can benefit in two ways from examining this article. First, the article illustrates an approach that can be used to evaluate forecasting techniques for time series of all types. Second, the article provides some basis for choosing a forecasting method if the characteristics of the time series are known.

RUSSELL BAREFIELD  
*The Ohio State University*

**Some Network Characterizations for Mathematical Programming and Accounting Approaches to Planning and Control**, by A. CHARNES and W. W. COOPER, *The Accounting Review*, January, 1967.

*The use of network models of linear programming is discussed. Possible relationships between mathematic programming and accounting are indicated. The use of mathematical approaches to decision making has significant implications for the future of accounting.*

A. Charnes is Walter P. Murphy professor of applied mathematics at Northwestern University, and W. W. Cooper is professor of economics and industrial administration at Carnegie Institute of Technology. The authors' backgrounds indicate the nature of the article, which is principally concerned with a mathematical approach to decision making. Two illustrations of mathematical techniques are offered in the article. The first deals with PERT and Critical Path analysis of the "time" required for a project. The second is a "goods-flow-funds-flow model." An additional illustration, included in an addendum, discusses a "transportation type" model using node-node incidences.

The first illustration is a process accounting problem similar to pro-

duction scheduling. Determination of time required for a project involves the use of a project graph (flow chart), formulation of an "incidence matrix" (network), and an analytic characterization (mathematical formulation). The example considers two variables (processing time for each operation and total processing time) and six stipulations (required processing operations). A stipulation in relation to a variable forms a constraint upon the decision. The use of linear programming can maximize processing time for each individual operation while minimizing total processing time.

The second illustration is a problem of determining the optimal amount of goods to be purchased and the amount of goods to be sold to maximize net profit. A buying constraint of warehouse capacity, a selling constraint of sales from inventory only, and a liquidity constraint of a minimum cash balance are incorporated into the illustration. A node-link network (flow chart) is presented to reflect this information visually. This network is expanded to display visually how the planning information can be incorporated into accounting records on a functional basis as a planning device for the entire organization. Probabilities can (and probably should) be incorporated into the analysis.

The planning of optimal size of variables can be facilitated through "double-entry accounting." These variables need not be restricted to dollar amounts; quantity units or time could be used. This approach requires that future costs, opportunity costs, optimal variables, and the like be incorporated into the accounting records. If this is done, accounting records will not only provide better data for decision making, i.e., planning, but will also function more efficiently as a control device.

Obviously the suggestions are aimed at management accounting as opposed to financial accounting, i.e. reporting to stockholders. Because of the advent of the com-

puter and recent advances in linear programming and other decision making techniques, decisions are being approached more mathematically. Thus, the approach suggested by the authors has important implications for the accounting profession. The full cost system will no longer be adequate for management purposes. Historical costs, average costs, or normal costs ". . . are rarely valid for the actual situation [decision] encountered."

### **Terminology**

This scholarly work contains 65 footnotes and 96 references in the bibliography. The terminology is not of a sort with which accountants and managers are typically familiar; terms used include incidence relations, figure of merit, Kirchoff node conservation laws, stipulations, Duality theory, Boolean-relational algebra, and functional efficiency. Therefore, this article is not easy to read; it must be studied to reap full benefits. A knowledge of linear programming and a mathematical orientation are useful in interpreting the article.

One who is not familiar with the mathematical approach to financial decision making may find it beneficial to read *Analysis for Financial Decisions* by William Beranek (listed in the authors' bibliography) before attempting this article. Beranek discusses "mathematical" decision making in terms more familiar to the businessman.

The network characterizations in this article may be useful as a learning technique; however, it is difficult to see how matrices could be used in many actual decisions because the variables are too numerous to display conveniently in matrix form. This does not destroy the validity of the authors' approach but merely indicates that mathematical formulation of decisions may be more significant.

The contribution of the authors is not so much in their network characterizations as in their implication that accounting for man-

agement purposes will have to change dramatically to keep pace with the advances in decision making techniques and the related data requirements.

RICHARD L. STRAYER, CPA  
*University of Southern California*

**The Bond Refunding Decision as a Markov Process** by HAROLD BIERMAN, *Management Science*, August, 1966.

*A refinancing decision, Professor Bierman argues, should be made by comparing refunding now with refunding later. He presents a probabilistic Markovian model for dealing with this type of decision.*

Corporate accountants and financial officers commonly consider the potential advantage of refinancing long-term debt whenever market rates of interest fall below the effective rate on currently outstanding issues. The traditional approach to this problem has been to compute the discounted cash flow advantage or disadvantage of refinancing now versus not refinancing.

A more meaningful way of viewing the decision, this author suggests, is to compute the advantage or disadvantage of refunding now versus refunding at some later date, allowing for the uncertainties of future movements in interest rates. Given this framework for the decision, the author presents a probabilistic Markovian model for dealing with future interest rate movements. He then incorporates the model into a preliminary algorithm for dealing with this more complex type of refunding decision.

In this kind of problem the decision maker must weigh the present value of refinancing at a given rate  $n$  periods in the future, declining as  $n$  gets larger, against the probability that the rate will fall still lower if one waits. Using a Bayesian expected gain approach, his algorithm presents a way of

choosing among decision rules of the type, "refund if the interest rate falls to  $X_1$  per cent in period 1,  $X_2$  per cent in period 2, . . . or  $X_n$  per cent in period  $n$ ." Using this approach, the company can determine the interest rate that should trigger refunding, taking uncertainties about the future into account.

Some limitations placed on the model by two rather restrictive assumptions incorporated in it are discussed. The first of these is the assumption that one can somehow obtain the transition probabilities matrix which forms the basis for the entire analysis. Professor Bierman argues that a satisfactory matrix can be developed by appropriately combining historical evidence and subjective management judgment. The second limiting assumption he discusses is the use of a linear (monetary) loss function in determining the expected value of various possible decisions. He acknowledges that since uncertainty itself may represent a significant part of the relevant loss function, monetary expectations alone may not be an appropriate base for decision making.

There is a broader kind of limitation which is not discussed. It stems from the assumption that a single-stage Markov process is a valid way of representing transition probabilities in the first place. What evidence is there that interest rates in period two are solely a function of the rates in period one? It could be argued that an  $n$ -stage process in which rates in period  $m$  are a function of rates in each of the  $n$  preceding periods is more reasonable.

Secondly, assuming a one-stage conceptualization is adequate, how do we know that the transition matrix at some point in time is independent of the particular interest rate that exists at that time? It is conceivable that the matrix of switching probabilities might look quite different if the current market rate were seven per cent than if the market rate were only four per cent. The Markov model assumes (reasonably?) that the

transition matrix is independent of the starting value.

Finally, granting both of the first two assumptions, how do we know that the transition matrix is constant over time? It is entirely possible that the matrix itself changes as well as the interest rate and in a manner not related to the market rate as mentioned above. Problems such as these have led many researchers to reject simple Markov processes in business applications, despite their intuitive appeal.

Although these problems limit the practical applicability of this model, they do not detract from the overall significance of the article. It represents a dramatically new way of looking at a longstanding problem. The traditional "now versus never" formulation has the effect of eliminating from consideration many of the really crucial complexities of the refunding decision.

JOHN SHANK  
*The Ohio State University*

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**A.** No. They must be bought in conjunction with E Bonds of the same or larger face amounts.

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**Q.** How will the Freedom Shares be registered?

**A.** Registration must be identical with the E Bonds bought in combination.

**Q.** Are Freedom Shares subject to taxation?

**A.** The same as E Bonds. Interest is subject to Federal income tax, which may be deferred until maturity or redemption (whichever comes first). Interest is not subject to state or local income taxes. Current values are subject to estate, inheritance, gift, and other excise taxes, both Federal and state.

**Q.** Will Freedom Shares be extended beyond maturity, as E Bonds have been?

**A.** No. Under existing law, there is no provision for extension.

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