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

Volume 1 | Number 4 Article 10

9-1964

# Management Services, Vol. 1, No. 4, September-October 1964 [whole issue]

American Institute of Certified Public Accountants

SEPTEMBER-OCTOBER, 1964

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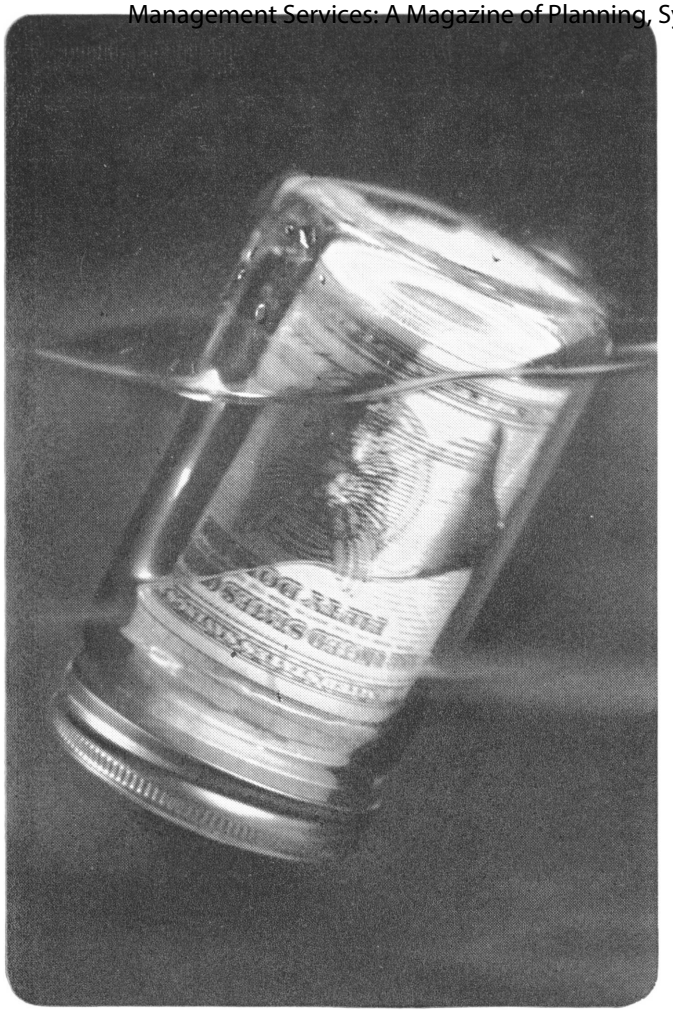
# MANAGEMENT SERVICES

*a magazine of planning, systems, and controls*



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



# Waterlogged in Warsaw

Mention flooded basements to Lloyd Adams of Warsaw, New York, and he'll probably take a friendly swipe at your head.

It all started when Mr. Adams buried a glass jar containing $1625 in Savings Bonds under his home. A heavy rainstorm, an unusual amount of seepage, and a leak in the jar produced a gummy wad that bore little resemblance to the former family savings.

Fortunately, the Chicago office of the Treasury Department could check the record of Mr. Adams' purchase, and issue new Bonds—no charge. (Mr. Adams sent them the serial numbers, but the Treasury could have traced the Bonds even if he hadn't.)

# Bailed out in Chicago

Every Bond purchase is recorded on film so it can be quickly traced, and the Bond replaced if lost or destroyed. This helps make Savings Bonds one of the safest places in the world to put your money. Uncle Sam guarantees it.

And incidentally, the more Bond dollars you lend Uncle Sam, the stronger our country will be. And the straighter Uncle Sam can stand up for freedom. Aren't those both pretty good reasons for you to buy Bonds?


**Quick facts about Series E Savings Bonds**

- You get back $4 for every $3 at maturity
- You can get your money when you need it
- Your Bonds are replaced free if lost, destroyed or stolen
- You pay no state or local tax and can defer payment of federal tax until the Bonds are cashed

*Buy E Bonds for growth—H Bonds for current income*

**Help yourself as you help your country**

# BUY U.S. SAVINGS BONDS

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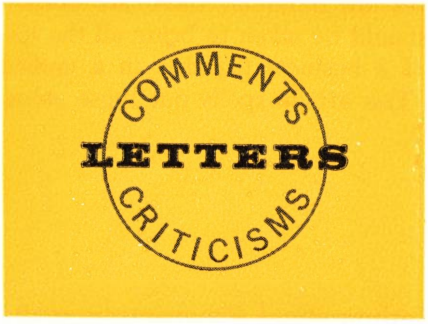


**One source of help**

I was interested by [Mr. Albert J. Storich's] letter in the July-August issue of MANAGEMENT SERVICES, and am surprised that the editor did not refer to probably the best source of easily available materials on small-small business problems: publications of the Small Business Administration.

You may know that for some three years the SBA has been publishing scores of Research Summaries that telescope the findings of often lengthy studies of practices of small businessmen. Several years ago the SBA let out about 100 research grants to bureaus of business research in universities and colleges around the country in order that they would undertake studies of how small businessmen solve their problems. Several of these reports have dealt with accounting problems. The University of Kentucky did three particularly good reports, *Pricing Decisions in Small Business, Accounting in Small Business Decisions,* and *Investment Decisions in Small Business*—each available for $3 from the University of Kentucky Press, Lexington.

In addition to the Research Reports and their brief Summaries, the SBA has put out, over the years, Management Aids, which are four-page explanations of how to begin to attack selected small-business problems, written by consultants and other experienced individuals, and containing bibliographical references for further reading. SBA will gladly put you on their mailing list without charge for both Research Summaries and Management Aids.

SBA also has published several 70- and 80-page booklets on such special topics as cost accounting for small business and financial analysis for small business. I suggest you contact your local SBA office for further information. I think you will get a great deal of help from this source. . . .

*Stephen A. Zeff*
*Visiting Associate Professor*
*University of California, Berkeley*
*School of Business Administration*

**Top rating**

It has been a long time since I have found a publication as interesting as your MANAGEMENT SERVICES magazine. It has already earned a top rating on my reading list. . . .

Your selection of material to date is excellent. I hope you can maintain the high standards which you have set for yourself.

*Charles W. Hill, Controller*
*State of Rhode Island*

**. . . too long hair**

Our firm is small, our clients are small, your understanding of our management services problems is small.

A small statistic (U. S. Department of Commerce, 1963): Of 4,470,700 industries, 4,388,000 had 49 or fewer employees. Us small guys want to learn how to help the small guys. Won't you please help us?

*Daniel A. Winters, CPA*
*Media, Pennsylvania*

**High quality**

Just a word of congratulations to you on your important new magazine. . . . I am very favorably impressed with the fine format, high quality of the articles, and the interesting news items.

You may be interested to know that readings from both *The Journal of Accountancy* and MANAGEMENT SERVICES are assigned to my graduate students for management accounting and advanced tax and accounting courses in our MBA program at Seton Hall University. . . .

*Charles J. Weiss*
*School of Business Administration*
*Seton Hall University*

SEPTEMBER-OCTOBER, 1964

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Management Services, September-October, 1964. Published bimonthly, Volume 1, Number 4. Subscription rates: $7.50 a year, $1.25 a copy. Publication, editorial and business office: 666 Fifth Ave., New York, N. Y. 10019. Second-class postage paid at New York, N. Y., and at additional entry office. Change of address notices and orders for subscriptions are to be sent to 666 Fifth Ave., New York, N. Y. 10019. Subscribers ordering an address change must give four weeks' notice and both old and new address, including postal zone and Zip Code number. 

# people, events, techniques

## Banks Getting Deeper into Data Processing Services Work Despite Warning that Returns May Not Justify the Effort

More and more banks are getting into the business of offering data processing services to other banks and to commercial and industrial customers.

Effective September 1, Central National Bank in Chicago purchased Radio Corporation of America's midwest electronic data processing center. The original value of the equipment thus acquired exceeded $1 million.

Central National Bank already provided a range of data processing services, including payroll, accounts payable, freight payment, and accounts receivable programs. The new equipment will make immediately available demand deposit accounting, savings accounting, and consumer loan accounting. Other services will be added later.

Central National's program is among the most spectacular of such moves but hardly unique. More than 500 banks now have computers installed, according to a survey reported at the recent National Automation Conference of the American Bankers Association, and nearly half of them are offering some sort of data processing service. Indeed, A. R. Zipf, senior vice president of Bank of America, compares the "stampede" to offer computer services to the "computer hysteria" of the 1950s, when computer systems were installed "without even rudimentary thought about their costs, their efficiency, and, most important, their applicability to the job that needed to be done."

### *Services offered*

The computer services most frequently offered, in addition to demand deposit accounting and other

MANAGEMENT SERVICES

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banking applications, are accounts receivable and payroll accounting.

But some banks are taking on work often performed by accounting firms. Mellon National Bank and Trust Company, Pittsburgh, offers a complete bookkeeping service to doctors and other professional men. The bank keeps records, makes up bills, mails them out, and collects remittances.

Others are getting into areas closely related to management consulting. The computer center operated by The Waterbury (Connecticut) National Bank has performed engineering calculations, sales analyses, product line profitability studies, and production and inventory control applications.

### *Bank advantages*

Differing opinions on the desirability of this trend were expressed at the bank automation conference. Neal J. Dean, vice president of the consulting firm of Booz, Allen & Hamilton, Inc., suggested that such customer services could make a profit contribution, through net fee income, of at least 10 to 15 per cent of a bank's net operating earnings, in addition to providing "new business values" and helping to retain balances. In this field, he pointed out, banks have "several major assets—the equipment, the trained staff, the professional customer relationships, and the reputation for both reliable and confidential data processing." If bankers use their imaginations, Richard W. Sherman, Mellon vice president, declared, "there is no end to the kinds and scope of financial services we can offer through the application of new technological advances."

### *Idle time trap*

Others urged caution. Mr. Zipf warned against getting caught in "the idle time trap." If there really is large-scale idle time on a computer system, he said, "it means that we have purchased a system far too extensive for our needs." Furthermore, "almost universally, the idle time on a computer does not coincide with the time the computer must be used to provide additional service to outside organizations."

### *Marginal economics*

Other speakers emphasized how difficult it is to make a profit on computer services. "The economics of the traditional independent service center has been marginal at best," Joseph A. Gallagher, vice president and treasurer, Valley Industrial Bank, Jenkintown, Pennsylvania, pointed out. "Even well managed, potentially profitable bureaus operate at a loss during the first three to five years." The reasons: "Competition for the very narrow application areas is acute, causing vicious pricing problems. . . Applications which offer a true profit possibility, such as scientific management techniques, seem to have little sales potential . . . due largely to a lack of understanding, a lack of sufficient pressure to force their adoption, and a lack of understanding relative to the advantages to be gained by their adoption."

### *Staffing*

Furthermore, management services consulting requires specialized staff. "Don't assume you can learn another man's business and do it better and cheaper than he can in a short period of time," Mr. Zipf cautioned. Services like sales analysis and inventory control, according to J. Daniel Walsh, vice president, New England Merchants National Bank of Boston, can interfere with the progress of in-house applications, drain resources and manpower, and generate "more customer ill will than goodwill." Merchants National concentrates on "bank oriented applications" and refers miscellaneous computer services to the national computer service firm of C-E-I-R, Inc. "You cannot be all things to all people," Mr. Gallagher concluded.

## Computers Can Be Taught to Evaluate Themselves Through New Automatic Machine Selection System

Computers have been weighing the pros and cons of alternative management actions for a long time. Now they seem to be about to carry this service to its logical conclusion—evaluating themselves so that companies can be sure they are installing the right computer for the job to be done.

### *ASDEC*

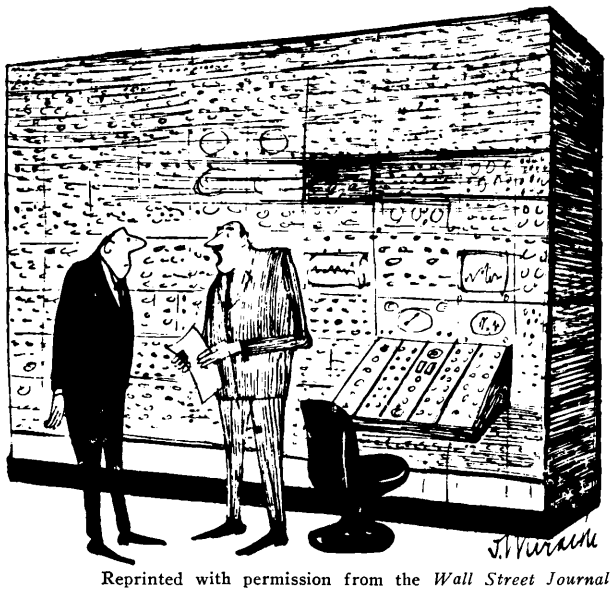
The Ballistics Research Laboratories at Aberdeen Proving Grounds have worked out a way to automate the process of comparative evaluation of electronic digital computing systems for specific applications. Data on each of 406 computing and data processing systems were entered on punched cards. Then a computer program known as ASDEC (Automatic Selection of Digital Electronic Computers) was prepared to evaluate them. The results, BRL claims, prove the feasibility of using a computer to pick the best computer to use for a given application.

BRL entered 43 facts about each computer on 80-column punched cards. The information, including quantitative and qualitative engineering and programing data, was taken from four BRL survey reports and from recent announcements by manufacturers.

### *Selection procedure*

This store of information could be used in various ways. For computer selection BRL suggests the following procedure:

Translate the computer application requirements into a set of desired programing and engineering characteristics, stating numerical



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"I just had it figure its value to us, and it came to considerably less than we paid for it."

values or ranges of values desired, and weight each of the characteristics in accordance with their relative importance. Then write a computer program that will examine each characteristic, assign the weights in accordance with prescribed rules, and accumulate a score for each system. Have the computer print out, in sequence according to score, the names and characteristics of all systems and evaluate the relative ability of each system to cope with the problems of the application. Then management judgment can be exercised in choosing among the highest-scoring machines.

### *Advantages*

The system has a number of advantages, according to BRL. Every time a new computer or computer modification comes out, new or revised cards can be punched; thus, the system is easy to keep up to date. If kept up to date, ASDEC eliminates the need to prepare a chart of comparative characteristics every time there is need to select a computer. The information, usually contained in bulky reports, is conveniently tabulated and is stored and displayed in a minimum of space. Evaluation can then be made systematic instead of hit or miss.

### *Other uses*

The same basic technique, sometimes with differing computer programs, could be used to answer questions like these: Is there a less expensive machine than the one I have that will do as good a job? Should I rent, buy, exercise purchase options, or buy time on someone else's machine? What is the average cost of a given computer system per pound, per bit of high-speed storage, per bit of intermediate storage, per installed transistor, per cubic foot, or per any other standard? Or, for a given class of computers, the year-by-year average of given characteristics could be plotted and extrapolated to forecast trends in the design of computers of the future.

"Far too many arbitrary selections of specific systems are being made today independently of the performance characteristics of the system," the BRL report warns. A system like ASDEC could go a long way toward making choices more rational.

## Service Contracts Found To Be Costliest Method Of Office Maintenance

Use of a service contract is the costliest way to maintain office equipment.

At least, that is the conclusion reached by Buyers Laboratory, Inc., an independent testing organization, after a survey of the repair experiences of 462 organizations operating more than 250,000 electric and manual typewriters, calculators, adding machines, and dictating machines.

### *Comparative costs*

The companies surveyed spend some $2,797,500 to service the nearly 100,000 of their office machines that are under contract. Servicing the same machines on a per call basis or by internal repair departments, at the average costs for these methods reported in the survey, would cost $1,215,205.

The extra cost may or may not be made up by time saved because of fewer breakdowns; the companies were not asked to compare downtimes under the various methods of maintenance. Avoidance of breakdowns through preventive maintenance is, of course, one of the chief reasons for service contracts.

As the Buyers Laboratory report notes:

"Good preventive maintenance, involving not only thorough cleaning but also careful inspection with detailed checking of operation, can mean at the least more satisfactory performance. At the best, it can mean fewer service calls, less downtime for repairs, and perhaps longer machine life."

### *Discontinuances*

However, as the report also points out, "All too often . . . periodic inspection and cleanings are hastily and indifferently performed and of little, if any, value." About half of the companies in the survey had

discontinued their service contracts on at least one of the five types of machines, most often manual typewriters and adding machines. Only a few did so because of "unsatisfactory service"; usually their aim was to save money.

The average service contract on an electric typewriter, BLI found, costs about $34 a year; the cost of per call service averages about $18 a year per machine. For the other four types of equipment, contract servicing costs anywhere from 87 per cent to 180 per cent more than per call or in-plant service.

Actually, the laboratory suggests, each case should be studied on its merits. After all, the figures cited are averages, and some companies paid less for contract than for per call service. Many of the companies surveyed have service contracts on some machines and use per call service for others. Even large companies with in-plant service facilities use service contracts selectively.

A majority of the companies operating fewer than 1,000 machines use service contracts for maintenance of all office machines except manual typewriters. Those with more than 1,000 machines are more likely to rely on in-plant maintenance or, more surprisingly, on per call service.

## Survey of Big Companies Shows Their Computers Have Saved Enough to Pay Back the Investment

A spate of surveys in the last couple of years has found many companies that use computers unconvinced that they are getting any dollars-and-cents payoffs from their electronic equipment.

Now a Cornell University study has come up with the opposite conclusion. Thirty of the 32 companies whose managements were interviewed by consultant Ernest Dale felt that their computer installations had produced at least enough cost savings to pay back the investment.

It's true that the companies whose experience is reported in Dr. Dale's study, "The Decision-Making Process in the Commercial Use of High-Speed Computers," are not typical of American industry as a whole. They were picked for their "leadership in size, profits, and progressive attitude."

Even so, the study should make cheerful reading for the computer industry. Only two companies had failed to retrieve what they spent on installation, servicing, rentals, and overhead. Twenty-six reported actual cost savings, sometimes in the millions of dollars. One claimed a 33 per cent reduction in clerical costs.

About half the companies had achieved measurable savings in labor costs, and all but three felt they were either using fewer people to do the same amount of work or using the same number of people to do a greater amount of work. It was impossible to determine, however, to what extent this improved efficiency resulted directly from the new equipment and to what extent from associated changes in procedures.

Some of the personnel reductions reported were impressively large. One insurance company laid off 4,000 employees; an oil company, 1,000. Two companies cut their clerical staffs by 10 to 15 per cent. Only six companies actually made layoffs, however; in 26 companies the staffs were reduced by attrition.

Even the companies whose computers had paid off reported plenty of past problems with the equipment. Generally, this was because both the computers and their application turned out to be more complex than the users had expected.

They found they had underestimated the number of program steps required, the time required for systems design, the conversion expense, the amount of post-changeover testing and reassembly required, the difference between actual computer processing time and the total time required to do a data processing job, the amount of programing needed to maintain a system, and the amount of clerical work involved in support activities. Some also complained of shortcomings in equipment reliability.

### *Total systems*

A few companies had tried to apply the concept of a "total system," in which all major input data are available and can be used repeatedly for different purposes, but this effort, Dr. Dale reports, "does not seem to have worked out anywhere."

For the most part the computers were being used to replace clerical workers in accounting, inventory record keeping, payroll processing, and the like. Other applications included location analysis, coordination of manufacturing and selling, facility and plant design and operation, and "individualization" (centralizing customer services and parceling them out individually).

Even in this group of large companies such advanced applications as forecasting, long-range planning, investment analysis, budget and sales analysis, and cost optimization were rare.

### *Operations research*

The executives interviewed were not impressed by operations research. Those who had tried it found the results disappointing, not very different from the results attained by traditional methods. One company, for example, is said to have spent between $500,000 and $1 million on OR analysis of a capital project only to come up with the same answer as the department manager, who had been conducting his own brief and inexpensive study. There were problems in this company with price variations, the extreme complexity of the business, the inability of computer program-

ers to handle esoteric OR approaches, and the operations researchers' inability to communicate their ideas.

One president said, "Too many factors which cannot be foreseen appear in the course of working out the results." Another chief executive summed up his opinion of operations research this way, "These OR applications are based on drawing a straight line between unfounded assumptions and a foregone conclusion."

As a result, Dr. Dale concludes, in these companies computers are used principally for repetitive jobs and "to a much less though increasing extent for middle management problems. Computers have by and large not even touched the fringe of top management . . . or made serious inroads into middle management, and there is not as yet much evidence that they will."

Similarly, he finds, predictions of marked trends toward either centralization or decentralization as a result of computers have not yet materialized. The equipment has brought more centralization of information processing, but the responsibility for decisions on how to use the information has not yet shifted away from the current decision makers.

## Number of Profit Sharing Plans in U. S. Industry Is Estimated at More Than 115,000–and Growing

Profit sharing is more widespread in American industry than is generally realized, the Profit Sharing Research Foundation has concluded after a survey of 6,135 companies with less than 500 employees.

### *Growth*

On the basis of this sample, the foundation estimates that more than 115,000 U. S. companies—including about one-fifth of all companies with more than 50 employees—have profit sharing plans. This total is two to three times that of previous estimates, according to the foundation's director, B. L. Metzger.

Furthermore, PSRF reports in its new study, "Profit Sharing in Perspective in American Medium-Sized and Small Business," the growth of profit sharing is running neck and neck with that of pension plans. For cash-payment profit sharing plans there are no earlier statistics since the current PSRF study is the first to cover companies with fewer than 500 employees (a category in which more than 99.5 per cent of U. S. companies fall). However, 5,016 new deferred-payment profit sharing plans were qualified by the U. S. Treasury Department in 1962, compared to 5,188 new pension plans. By December 31, 1962, the number of qualified deferred plans had reached 33,522. There were only 37 in 1939. Indication that the number of cash plans is also growing is given by the median age of the cash plans reported in the PSRF survey—eight years, compared to five years for the deferred plans.

Cash-payment plans predominate in companies with fewer than 20 employees. Larger companies are more likely to defer payments or use a combination of immediate cash and deferred payment.

### *Participation*

Only 2.5% of the companies surveyed limit participation in their profit sharing plans to executives. In half the companies between 80% and 100% of full-time employees are included, usually after a waiting period; in three-fourths, more than 50%. In a majority of plans the only employees excluded are union workers, and they are covered too in 47% of the plans.

The fund available for distribution to employees is calculated by means of a predetermined formula, usually a percentage of total company pretax profits, in two-thirds of the companies. Of these, two-thirds share profits after a prior reservation to stockholders.

### *Contribution*

The most successful plans, according to PSRF, seem to be those in which the annual company profit sharing contribution amounts to between 8 and 15% of participating payroll. "Development of an equitable company contribution formula is very important in profit sharing," the report notes, adding that "competent professional advice can assist management in this area."

More than 80% of the companies surveyed rated their plans as successful or very successful in meeting their stated objectives. The most common objectives, in order of frequency of mention, were to increase employee incentive, to enhance employee security, to give employees a sense of partnership, to attract and hold competent people, and to reward employees for outstanding service. (Only 11% cited tax advantages.)

### *Disappointments*

Only 2.3% of the companies were disappointed in their profit sharing plans. The disappointment rate was twice as high among companies with cash plans as among companies with deferred and combination plans. Similarly, more companies with deferred than with cash plans found them very successful. The annual rate of discontinuance of cash plans is more than double that of deferred and combination plans, 2.7% compared to 1.2%.

Successful plans tend to have broad employee coverage, rapid and complete vesting of employer contributions, and high average annual yields. Plans rated disappointing encountered the following handicaps to success: "inadequate" sharing formulas, faulty communications, and lean profit years.

# Improvements in Quality and Reductions in Prices Promise Computer Users More for Their Dollars

More computing ability per dollar spent is promised by the manufacturers of several new electronic computers introduced in the past few months. In addition, several manufacturers have announced price cuts on existing equipment. Both developments reinforce the growing trend toward lower costs for computer users.

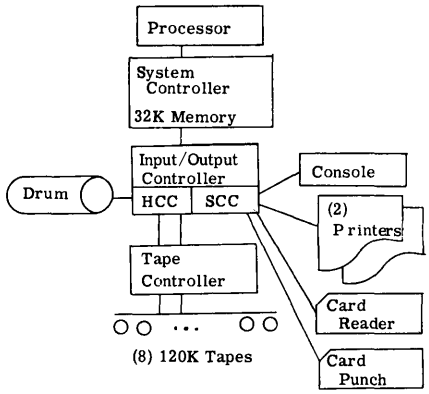
### *Higher performance*

General Electric's Computer Division has taken the wraps off the 625 and 635, two members of its new family of large-scale computers known as the Compatibles-600. The 635, the largest in G.E.'s line, has a two-microsecond (millionth of a second) memory cycle; the smaller 625 has one-microsecond memory.

Rentals are high ($45,000 a month and up for the 635), but so is performance; the 635 can add well over half a million numbers a second. Advanced features promise "far more computing per dollar than other large-scale computers," according to G.E. These features include memory-oriented design (central memory can be addressed directly by active system components); multiprograming in normal operation (two or more programs stored in memory will be executed virtually simultaneously on a time-shared basis); and multiprocessing (several computers work together to process large amounts of data). Deliveries begin this year.

Burroughs Corporation's new B5500, another large-scale machine, also offers "extremely high productivity . . . measured against the dollar investment." Its features include simultaneous handling of two or more programs, modular design, and a memory unit that can manipulate a character of information in 250 billionths of a second.

The B5500 has up to three times the capacity of Burroughs' older




**General Electric Company's new 600 family of large-scale computers rounds out its line to twelve machines. The two 600 models, GE-625 and GE-635, differ chiefly in speed. Both are compatible with medium-scale General Electric equipment.**

B5000, yet its rental cost—from about $20,000 a month up—is, on the average, only about 25 per cent higher than that of the B5000. Deliveries will begin early next year.

Univac's new 1108 large-scale general purpose computer rents in the same range—an average of around $45,000 a month—as its predecessor, the 1107, but is more than five times as fast. Memory cycle time of the core memory is 750 billionths of a second, but the memory is divided into two separately accessed banks, a feature that halves the access time in practice. Delivery will begin July, 1965.

### *Lower prices*

Meanwhile Radio Corporation of America has reduced purchase prices and rentals of its 3301, a medium-to-large-scale system, by 25% to 35%. Control Data Corporation has dropped prices and rentals of its computer line by 5% to 15%. Scientific Data Systems, Inc., has come out with a new leasing schedule that will lower rentals an average of about 15%.

In announcing the price adjustments the manufacturers cited as major reasons increasing competition, production economies resulting from larger volumes, and lower costs of components, particularly transistors. The first two factors probably represent continuing trends. And further cost-cutting technological improvements undoubtedly lie ahead. For example, some manufacturers are working on such devices as fluid amplifiers (controls based on fluid pressure rather than electrical impulses) to replace some transistors in smaller, slower computers and peripheral devices; fluid amplifiers are cheap and reliable but slow.

# For a Growth Company Pick a Growth Industry

The surest way to build a growth company is to pick a growing business to be in. That is the conclusion reported in *California Management Review* by Peter M. Gutmann, lecturer in economics at City College of New York, following a study of 53 manufacturing companies that have achieved exceptionally rapid expansion in sales, total profits, and profits per share.

The 53 companies were engaged in 65 industries that, in total, grew more than twice as fast as manufacturing as a whole in the period studied (1954-58). More than 70 per cent of the companies were concentrating on subsectors of these industries that were growing even more rapidly than the industries themselves. And many also had focused on fast-growing market segments within the subsectors.

For the most part, the industrial subsectors selected were in an earlier stage of development than the industries of which they were part. As a result, only about half the companies had a large number of competitors (more than 15).

By picking the right industries in which to operate, nearly all the companies were able to grow even though they were selling old products to old markets. More than 80 per cent also were selling new products to these markets. Sale of new products to new markets was

an important strategy in only 40 per cent; sale of old products to new markets, in only 6 per cent.

Product and marketing strategies were closely attuned to the environment. For industries in early growth stages, the companies emphasized research and development and new products; for more mature industries, the stress was on price and advertising.

On the average, these fast-growing companies had a broad geographic spread. Two-thirds sold domestically manufactured products abroad, and about 40 per cent were engaged in manufacturing activities outside the United States.

## Clerical Pay Has Risen One-Third in 18 Years

Clerical salaries in the United States have gone up 32 per cent in the past 18 years, the Administrative Management Society reports after tabulating the results of its annual survey.

The nationwide weekly average (an average of 20 different jobs) is now $82, compared to $80 last year. Rates are higher than this in the West (an average of $88) and in the East-Central states ($83), lower in other areas.

The biggest pay jump last year was for senior accounting clerks—$5 a week. Top secretaries and intermediate-level tabulating machine operators now get $3 a week more than in 1963.

AMS also reports a continuing trend toward a shorter work week and more paid holidays. Although the 40-hour week is still standard, the percentage of companies with a shorter week has been rising and the percentage with a longer week has been falling. More than a third of the companies surveyed now pay for eight or more holidays a year; 27 per cent pay for six; and 26 per cent pay for seven.

Other trends: More companies are offering life and health insurance and retirement plans. And more are paying the premiums.

## Bank Executive Outlines Prudent Thinking Laws To Guide Computer Use

By following certain "prudently negative" guidelines, Chase Manhattan Bank has managed to enjoy the fruits of automation while avoiding its pitfalls, Charles A. Agemian, executive vice president, told the American Bankers Association's recent National Automation Conference. To help other organizations considering the use of computers, he outlined "Agemian's Laws of Prudent Thinking:"

1. *He who hesitates is sometimes saved.*

Early computer users got into trouble trying to adapt for business data processing purposes equipment designed for scientific computation. Even today there is a risk of trying to automate with an unsuitable tool.

2. *Think small and carry a big staff.*

Mr. Agemian called attention to two "interesting and simple facts: A small computer is conceptually and electronically no different from a big computer—but a lot cheaper. A small, complex clerical operation is structurally no more difficult to automate than a large, complex clerical operation—but considerably less risky to try." Chase Manhattan began with a limited automation project and concentrated on forming and training an adequate EDP staff.

3. *Automation doesn't cut red tape—it perforates it.*

By 1963 the bank had reached the point where over-all employment and operating expenses had gone down and activity and profits had gone up. But human input errors, communications problems, peak loads, and machine utilization gave rise to a whole new set of operating problems.

4. *One way to make the new automated system cost more than the old is to pioneer the wrong thing.*

Too many computer users, Mr. Agemian warned, are still falling in love with "the fastest tape speeds and the jazziest programing languages. . . I believe in pioneering, but I'll pioneer better operating procedures and better management information systems—not better machines and programing languages."

5. *Those who lean too far into the future will fall flat on their faces.*

"All things are technically possible," Mr. Agemian suggested. "For example, computers can 'talk' to each other; mass random access memories are greatly advanced. But prudent thinking tells me that all things aren't economically practical. The problem automation planners have is foreseeing when, in the future, technical achievement and economic feasibility will coincide—for a good planner is one who can not only think 'blue-sky,' but can implement it as well."

## Library Begins Applying New Computer System Of Information Retrieval

One of the first computerized information storage and retrieval systems has begun operating at the National Library of Medicine in Bethesda, Md. MEDLARS (Medical Literature Analysis and Retrieval System), a $3-million system built around a large-scale Honeywell 800 computer, is said by NLM to be the world's largest medical information storage and retrieval system.

MEDLARS' chief job at the library is preparation of *Index Medicus,* NLM's massive monthly bibliography of the world's medical literature. An average 500-page issue contains approximately 12,000 citations.

The library receives more than 300 medical journal issues each week. Its indexing staff selects articles, translates foreign titles, and indexes each article with appropriate descriptors (descriptive terms) from a controlled list of terms called MeSH (Medical Subject Headings). Unit records for each article, comprising regular bibliographic ci-

tations and associated MeSH tags describing the content, are entered onto perforated paper tape and fed into the computer. The machine then processes, compresses, and stores the records on magnetic tape.

Once a month the computer edits and cross-references all unit records stored in it during the month. This information is stored on magnetic tape for input to an optical output device called GRACE (Graphic Arts Composing Equipment), which automatically translates the computer output into high-quality photo-copy from which final printing plates are made. Complete pages are printed at a rate of 300 characters a second on positive photographic film or paper.

MEDLARS, which prepared *Index Medicus* for the first time in January, has helped reduce the total elapsed time needed to produce the volume to less than ten days, several days less than it would take the library staff to do the job. Actual computer time amounts to less than three hours. MEDLARS also does other jobs around the library, including the answering of demand search requests and preparation of recurring bibliographies on specialized medical subjects.

## NCR Offering Computer With Thin-Film Memory

National Cash Register Company has announced what it claims is the first commercially available data processor with a main memory entirely of thin-film elements.

Thin-film memories are faster and potentially cheaper than the core memories used in other computers. The new machine, the NCR 315 RMC (Rod Memory Computer), has an internal speed some eight times that of a comparable NCR 315 core memory. Basic cycle time is 800 billionths of a second. The new system can process approximately 100,000 instructions per second.

It will rent for about $6,000 and up a month. First deliveries are scheduled for mid-1965.

**PROJECTION OF AVAILABILITY OF OPTICAL CHARACTER RECOGNITION EQUIPMENT**

| EQUIPMENT | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | User Price $000 Min | User Price $000 Max | Capability: Max. Speed Documents /Min. | Capability: Max. Capacity Char./Doc. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fixed Data Line | | | | | | | | | | | 75 | 125 | 600 | 120 |
| | | | | | | | | | | | 40 | 70 | 1500 | 120 |
| Low-Speed Fixed Data Line | | | | | | | | | | | 30 | 50 | 150 | 120 |
| | | | | | | | | | | | 20 | 27 | 150 | 120 |
| Accessory Reading Head for Existing Transport | | | | | | | | | | | 30 | 50 | 1000 | 120 |
| | | | | | | | | | | | 18 | 25 | 1000 | 120 |
| Journal Tape (Cash Register Receipts) | | | | | | | | | | | 40 | 60 | 2400 lines/ | 35ch./line |
| | | | | | | | | | | | 25 | 35 | 6000 min. | 35ch./line |
| Journal Tape - (Stylized Font) | | | | | | | | | | | 18 | 30 | 2400 lines/ | 35ch./line |
| | | | | | | | | | | | 10 | 20 | 2000 min. | 35ch./line |
| Page Reader - High Speed Multifont | | | | | | | | | | | 250 | 350 | 400 | 1600 |
| | | | | | | | | | | | 100 | 140 | 600 | 2000 |
| Page Reader - Low Speed Standard font | | | | | | | | | | | 40 | 60 | 60 | 2000 |
| | | | | | | | | | | | 25 | 36 | 120 | 2000 |
| Micro-image* | | | | | | | | | | | | | 1200 | 200 |
| | | | | | | | | | | | | | 2000 | 500 |
| Hand-printed alpha-numeric | | | | | | | | | | | 60 | 80 | 1 | 50 |

Diebold Research Program

Over the next ten years, The Diebold Group, Inc., predicts, optical character recognition will largely replace key punching as a form of computer input. The consulting firm's forecast of equipment availability is shown above.

## Diebold Research Group's Initial Report Sketches Probable Large-Scale Computer System of 1970

Electronic computers will have even greater impact on business and the economy in the next ten years than they have had in the past decade, the consulting firm of The Diebold Group, Inc., forecasts in a report on the initial findings of its continuing study of probable developments in automatic data processing (MS, March-April'64,p.7.).

By 1970, The Diebold Group predicts, the typical large-scale computer system will have the following characteristics that will differentiate it from existing systems:

### *New characteristics*

It will be much less costly in relation to performance, thanks to growing competition among computer manufacturers and between them and the communications industry.

It will be a real time system.

It will be communications-oriented, with the cost of the central computer making up less than 30 per cent of the cost of the total system.

It will be tailor-made for its industry with special purpose peripheral equipment.

It will include graphic elements, display systems, facsimile transmission, and large files with capacities of 10 billion to 100 billion bits.

### *Innovations*

These new systems developments will be based on significant forthcoming technical innovations:

Image files will begin to replace or supplement digital files, at a much lower cost per bit stored. This development will revolutionize company engineering activities, through the introduction of automatic drafting, and also will affect technical research, by making full reference material available on an inquiry basis.

Mass random access memories, both digital and photo, and new communications devices will permit the economic development of centralized data banks to contain the total files of a corporation. As a result, corporate data processing ac-

tivities will become increasingly centralized, and a new industry—information service centers selling data on an inquiry basis—will develop.

Optical character recognition will largely displace key stroke methods for initial data mechanization in volume applications. As a result, the key puncher's job—and possibly other jobs created by the computer in recent years—will begin to disappear.

The use of punched cards will decline with such advances in data collection, input, output, and communications devices as facsimile transmission, touch tone dials, and visual display devices. Displays, today confined almost entirely to the military and scientific field, will become an integral part of most large-scale commercial systems by 1970; a reduction of almost 50 per cent in their cost is anticipated.

By the end of the next decade, speech recognition devices capable of recognizing dozens of different voices will begin to appear on a commercial basis.

## Small Business Getting Consulting Aid from SBA

Free consulting help is being offered to certain very small businesses under a new program sponsored by the Small Business Administration.

SBA has been recruiting retired businessmen to serve without pay in its Service Corps of Retired Executives. These men, organized into four-man teams providing a cross section of management skills, will give advice to those of SBA's problem loan cases that ask for the help.

The program got under way in Boston in August. By late fall it is expected to be operating in all 14 SBA regional offices throughout the country. It will not, SBA claims, provide any real competition for professional management consultants since its clients for the most part will be businesses too small to pay for consulting services.

# PATTERN FOR PLANNING

*As the need for business planning has intensified, the techniques for doing it have improved. By following these basic steps, any company should be able to produce a plan that is both motivating and controllable.*

*by Richard T. Cass*
*Alexander Grant & Company*

SOUND profit planning is both more important and more difficult than ever before in this age of rapid technological change. Fortunately for management, recent changes in production and marketing methods have been accompanied by substantial improvements in planning techniques.

The use of budgeting as a device merely to limit certain expenditures is disappearing. Instead, modern profit planning encourages action rather than restricts it. The growth of incentive systems based on profit plans, with recognition of divisional and departmental autonimy and responsibility within the framework of the plan, is evidence of increasing attention to the motivational aspects of profit planning.

No chief executive can abdicate his responsibility as chief planner, but he can reject the view that the budget is a restrictive authoritarian device. By bringing others into the planning process under his direction, he clarifies and expands their responsibilities to act, not merely to refrain from acting. Such participation under central direction can produce a plan that is both motivating and controllable, one that includes all the important elements of the business and brings them together in a unified pattern for profit.

How do you get this unified planned pattern? How do you formulate a plan that enables management to cope with complex and changing conditions and supplies information for rapid, informed decisions? And how do you make sure the plan is being followed?

There is no canned procedure for profit planning that can be adopted intact by every company. Because each organization has its own purposes and its own problems, business planning is a highly individual thing. Nevertheless, by following

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certain logical steps any company can make sure that its plan for profit is solidly based, complete, and developed in an orderly manner that facilitates subsequent control.

### *Definitions*

Before discussing these steps, let us briefly define some key terms. There is no mystery about business planning. The hackneyed analogies of the captain charting his ship's course and the motorist planning a cross-country trip are not really necessary to explain a simple idea. Still, even though the ideas are familiar, words mean different things to different people. These are the meanings that should be given to the terms that are used in this article:

A plan is a statement by a person that he intends to do a certain thing by a certain means. Planning is the process by which he develops that statement. Profit planning is business planning directed to the final objective of the business and generally including all the important elements of the business. Budgeting, a word that is sometimes understood in a purely restrictive sense, here will be used as synonymous with profit planning.

Control goes along with business planning. The term control may be understood negatively as the act of restraining or limiting. Or it may be understood positively as the action of initiating and directing activity in a definite manner for a definite purpose. It is in the latter sense that control is important to planning.

Planning and control are twin aspects of the same managerial activity. Like Siamese twins they cannot survive individually. A plan needs assured direction for its completion. Without that direction or control it has no practical value. The plan is preparation for action; control is the plan in action.

### *Basic steps*

There are six basic steps in profit planning:

1. Decide in general terms what you want to accomplish.
2. Take a look at what you have to work with.
3. Determine what will happen if no exceptional action is taken.
4. Decide very specifically what you want to accomplish.
5. Figure out, also very specifically, how you can get these planned results.
6. Follow up with an effective program of reporting and analysis of performance.

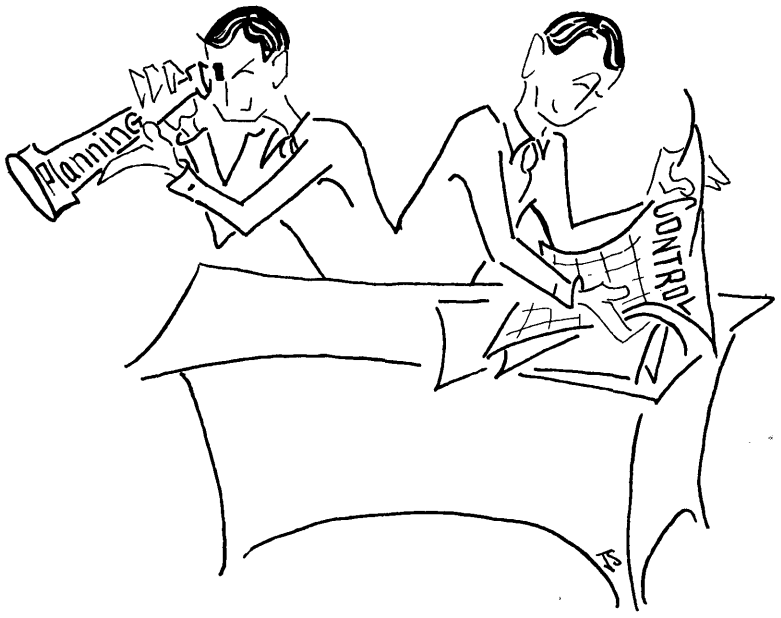
### *General course*

The first thing to do is to decide what you are going to plan for. The chief executive or the few people in the topmost management group should decide the general course the company should take in the period being planned. They may decide, for example, that this should be a period of expansion or one of retrenchment. They may decide to plan for survival, for moderate improvement, or for dramatic growth. This is the "big-thinking" phase of planning, but it should not be derogated, nor should it be omitted because it brings to the plan at its very beginning the intellects and judgment of the most responsible persons in the organization.

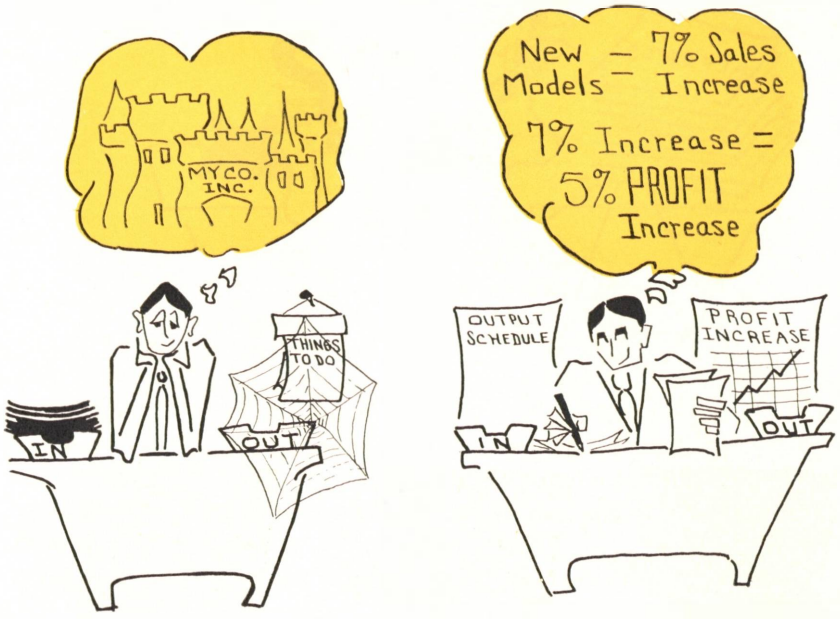
The decision as to the general course of the company should be carefully made. It will determine the purpose and climate of subsequent planning and the character of operating policy as well.

The objectives decided upon, no matter how general, should have quantities assigned to them. The statement "I want this company to go places!" is not a decision or a plan. It is a hope. But the statement "I intend to improve profit by at least five per cent during this coming year by expanding the product line to include these three new models, which will increase sales by seven per cent, and by keeping total expenses at their present level" is a decision and a plan, or at least the beginning of one. One need not be greatly concerned about the perfect realism of the target quantities planned at this stage. The amounts will be refined in a later step of the planning process.

This first planning step should be a comparatively brief one. Time




Planning and control are Siamese twin aspects of the same activity.




Unless objectives have quantities assigned to them, they are mere hopes.

spent can be kept to a minimum, since only one or a few persons will be involved in the setting of overall objectives.

### *Capabilities*

After the determination of the general course and objectives of the company, the next step is to bring oneself face to face with factual capability. Can the objectives really be achieved, or are they set too high? Or are they too low? This step, like the first, is largely the responsibility of the chief executive. But he begins at this point to bring others into the planning act. He does this by asking them to collect and interpret certain facts that will show him the present strengths and weaknesses of the company, its potential or lack of it. Here are examples of the questions he might ask: What is our rate of utilization of productive facilities? What is our share of market by product line and what is the trend? What is our rate of introduction of new products? What do we spend on research compared to our competitors? How many customers did we gain or lose last year? What shape are we in financially?

In this step the chief executive puts people to work. He must ask enough questions and require enough answers to provide himself with a clear idea of the capabilities of his organization. He himself will work hard asking the questions; checking the validity, honesty, and completeness of the answers; and interpreting the facts he obtains. And when he finishes, he will know his company better than ever before.

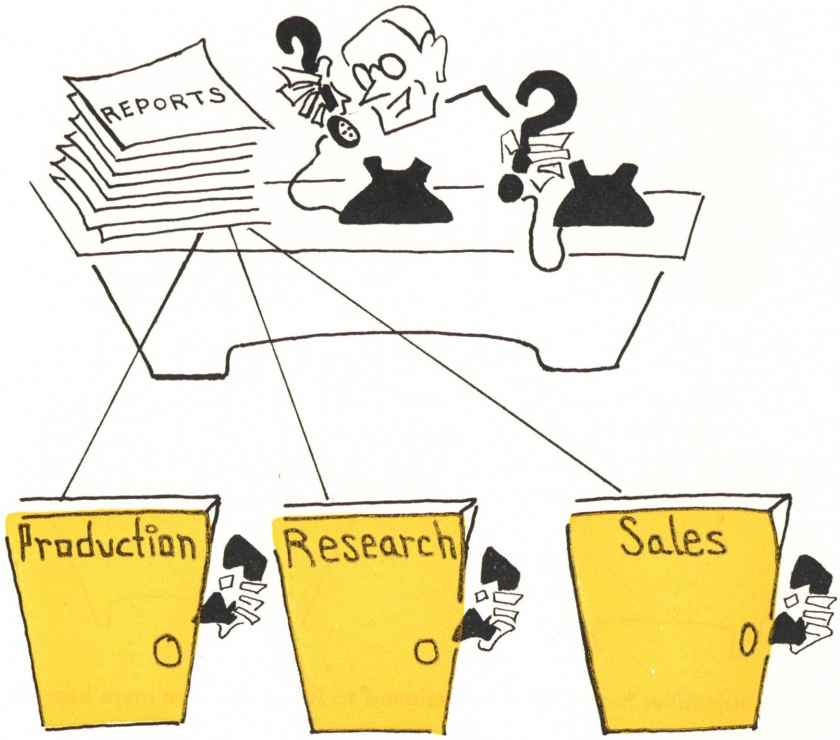
It is important that the information collected in this step be substantiated, organized, and written down. It will form a list of advantages to be exploited and deficiencies to be worked on. For this important purpose of corporate self-analysis, memory deceives and conversation obscures. An adequately documented written analysis, even if not completely detailed, is a reliable guide to improvement.

Unless some extremely critical defect is brought to light at this point, attention should not be diverted from the planning program toward the correction of specific defects. These defects will have been catalogued and will be considered in better perspective, in the context of the entire plan, as the planning process goes along.

Reviewing the facts he has collected about the good and bad points of the current operation, the top executive may revise the objectives and general plans which he formulated in the first step.

### *Projection*

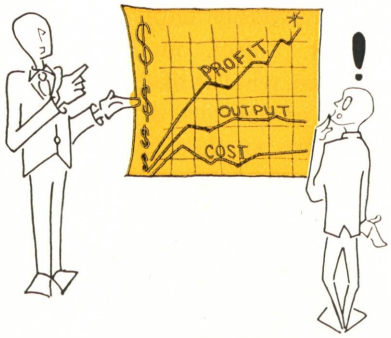
After developing a picture of the present operation, the next step is to project that picture without substantial change into the future. Some companies spend a lot of time planning to accomplish what will almost inevitably happen anyway. Why not project, on the basis of experience, what is likely to happen whether or not careful planning is done? Why not then take that projected result for granted as a minimum, and spend the real time and effort in planning to improve it? A projection like this destroys complacency. It puts pressure on the persons doing the planning and causes them to take steps to change




The information collected in the analysis of corporate capabilities will form a list of advantages to be exploited and deficiencies to be worked on.

the indicated course of events instead of drifting.

This projection should be a relatively simple one, based on experience and adjusted only for reasonably certain future changes. It should be detailed by responsibility area or by department. Later in the planning procedure, the head of each major department will be asked to develop his individual plan. The chief executive should be able to consult the projected data to determine whether a departmental plan is one of true improvement or of mere continuation. For example, if sales are shown as increasing in proportion to the increase in population, a sales manager may be told to plan more ambitiously.




Project what will happen without planning and then plan to improve it.

### *Specific goals*

Sufficient historical data should be assembled to make the projection statistically valid. Perfect accuracy is neither practical nor necessary, but the projection should be statistically honest to make it reliable as a base for action planning.

The next step is to decide just what to build upon that base. In Step One, total objectives and general courses were set out by top management. Those general objectives will probably have been modified in the light of the facts assembled in Steps Two and Three. In this, the fourth step, the objectives are made very specific. This is done by department managers, who will set for themselves individually attainable goals.

This should be done in a participative, not an anarchic manner. The over-all objectives originally decided upon should be retained. Individual objectives should be required to be in line with them. The objectives proposed by each individual should be thoroughly reviewed by top management. Revisions should be made to eliminate over-optimism and unwarranted pessimism. In a large organization this review process will take place through ascending levels of responsibility, but in all cases top management should be interested and involved in the review.

The objectives decided upon in this planning step should be very specific. This is the only way to establish a base for subsequent control. The objective "to increase sales" cannot be effectively controlled. On the other hand, "to increase sales of Product Number 127 in the Omaha territory by $20,000 and 4,000 units during the month of March" is an objective which can be controlled. The degree of detail re-

quired will vary among companies and among functions. How much detail is required? There should be enough specific detail about each objective so that the person immediately responsible and also his superiors can tell continuously whether the objective is being attained or not.

It might be argued that time and effort could be saved if top management presented specific objectives to department managers. This may be appropriate on occasion, but in general it is bettter for the detailed planning to be done by the persons who know the details best. In this way the broad knowledge and total requirements of top management are combined with the specialized knowledge and capabilities of the responsible managers in the field and factory. Also, it seems to work out that people who have a voice in setting their own objectives work hard to attain them and have a good chance of succeeding. A manager may have had to revise his originally proposed targets to come into line with the total objective, and perhaps he does not completely agree with his eventual assigned target. But at least his views have been heard, he knows exactly what is required, and he has better knowledge of why the requirement is what it is and why it is believed to be attainable.

In this planning step, when a number of persons become involved, communication becomes important. Having completed the first three steps, at this point the chief executive knows quite clearly what he wants and also what he can reasonably expect. Communication of his meaning should be relatively easy.

### *Means*

After deciding specifically what is to be accomplished, the next logical step is to figure out exactly how to accomplish those things. This is a reflection of the preceding step. Department managers should develop specific methods to accomplish the specific objectives they have set out. As in the preceding step, these planned methods should

**TABLE I**
**Departmental Plan**

ABC MANUFACTURING COMPANY, INC.

Inventory and Production Control Department

Planned Objectives and Methods
For the Year Ending December 31, 19...

| OBJECTIVES | METHODS |
|---|---|
| 1. Maintain inventory at an average level no more than 5% greater in total dollar volume than the average of the past year, despite a forecast increase in sales of 33%. | a. Using the annual sales forecast as a guide, establish base stock levels for each of the seven product classes. Total dollar value of the base stocks will not exceed last year's average inventory. |
| 2. Maintain a stable work force. Layoffs for the entire year because of lack of scheduled production will not exceed 5% of the direct labor force. | b. Schedule production to build and maintain the base stocks by producing in approximately equal amounts each month. Employ sales forecast data embodied in a weighted moving average to schedule production. |
| 3. Reduce items back ordered from 6% to 5% of total items shipped. | c. Compile a distribution of inventory items according to usage x value (ABC inventory control technique) based on inventory activity of the last three years. Use this information for<br>1. Setting base stock levels<br>2. Establishing priority by item for attention and expediting. |
| | d. Expedite production orders systematically:<br>1. Schedule starting dates for initial operation and for bottleneck operations.<br>2. When scheduled dates are missed, expedite orders according to scheduled date and inventory class. |

be reviewed by superior management and revised when necessary. Figuring out methods of accomplishment naturally tests the realism of the objectives, and some further revision of objectives may be indicated.

In this step also, individual plans must be thought out and enough specific detail expressed so that subsequent control is possible.

The review process is a valuable one. Criticism and discussion in the planning phase avert later misunderstandings. Potential problems—and likewise potential excuses—are considered in advance, in a highly rational climate. Timid managers are encouraged to act, and impulsive managers are restrained, before real damage is done by action or inaction. And in every case the chief executive is establishing a firm base for insisting on specific performance.

Depending upon the size of the organization, the written expression of departmental objectives and planned methods may require numerous worksheets and a sizable amount of written data. For illustration, however, the simplified example shown in Table 1 on page 17 may be useful.

### *Implementation*

Finally, after the plan has been set up in total and in appropriate detail, it is ready to be implemented under control. Performance needs to be reported, evaluated, and corrected. For this a regular, systematic program of reporting and analysis is necessary. The basic requirement of the information program is that it tell accurately, promptly, and in adequate detail whether you are doing what you have planned. The mechanics of the program are a matter for accounting and data processing technicians, but their guide to the reports required and the kind and amount of detail to be provided must certainly be the plan itself. The degree of detail in the reporting program should match that of the plan, so that department managers who have planned objectives and methods in considerable detail

TABLE 2 Steps in Profit Planning

| STEP | PURPOSE | COMMENT |
|---|---|---|
| 1. Decide in general terms what you want to accomplish. | a. To establish the purpose and climate of planning | a. Restrict activity in this step to top management. Be thorough but brief. |
| | b. To enable top management at the very beginning of the planning process to set policy in definite terms, which will be translated directly and specifically into the profit plan | b. Make objectives fairly definite. Express in dollar terms. |
| 2. Take a look at what you have to work with. | a. To bring realism to the objectives established in Step One | a. Begin to involve middle management in the planning process. |
| | b. To gain insight into the organization and the operation, highlighting points to be exploited and to be corrected | b. Revise objectives if necessary in view of factual capability.<br>c. Organize and record data developed in this step for future reference. |
| 3. Determine what will happen if you do nothing exceptional. | a. To avoid planned drifting, to preclude complacency<br>b. To prepare for critical evaluation of departmental plans<br>c. To establish an irreducible minimum standard of accomplishment | a. The projection must be statistically valid but need not be a perfect prediction in order to serve as a guide to action planning. |
| 4. Decide very specifically what you want to accomplish. | a. To begin to establish the plan in specific terms<br>b. To explode the plan into manageable segments | a. Active participation of middle management is controlled by decisions made and refined in Steps One, Two, and Three. |
| | c. To elicit the active participation of responsible line managers | b. Review and approval process assures top management that over-all |

TABLE 2 (continued)

| STEP | PURPOSE | COMMENT |
|---|---|---|
| | d. To establish a measurable base for subsequent control | objectives have been understood and translated into specific individual objectives.<br>c. Objectives should be expressed in adequate though not excessive detail so that action can be subsequently controlled. |
| 5. Figure out, also very specifically, how you can get these planned results. | a. To make sure of the practical capability of attaining each specific objective and the total<br>b. To bring final realism to the plan | a. Review process enables top management to communicate and enforce policy in a practical way in the planning stage, before irreversible action is taken.<br>b. Specific disclosure of planned methods precludes alibis.<br>c. As in the preceding step, appropriate detail must be provided to permit control. |
| 6. Follow up with an effective program of reporting and analysis of performance. | a. To inform each person at his own level of responsibility whether his plan is being successfully followed and to point to corrective action | a. Reporting system should be matched to the details of the plan to provide clues for investigation of causes of unplanned conditions.<br>b. Performance reports may point to a revision of departmental plans. Overall objectives should not be changed.<br>c. Performance related to plan helps in evaluating and rewarding management ability. |

receive similarly detailed performance reports, while top executives receive more comprehensive but less fully detailed information. The important thing is for each man at his own level of responsibility to know where he stands in relation to his plan. The reasons for unplanned conditions can never be disclosed fully by an accounting system, but analytical accounting techniques should be used to isolate exceptions and provide clues for investigation. Causes can be found when you know what to look for.

### *Revision of plans*

Reporting, analysis, and investigation will ordinarily lead to corrective action within the original framework of the plan. Sometimes, however, a revision of plans is indicated. There are two schools of thought on the subject of revising an operating plan. One holds that the plan must never be revised in any detail. Another permits the plan to be revised readily for accommodation to actual performance. The former has the virtue of determination but may sacrifice realism. The latter attempts to maintain realism but sometimes degenerates into planning by retrospect. Neither is totally right or totally wrong; (P. E.) there is a sensible middle ground.

Long-range plans and total objectives are based on an assessment of factors that are relatively unchanging and predictable in their total effect. Temporary changes in underlying conditions, therefore, should not be allowed to alter original long-range plans or over-all objectives. On the other hand, departmental plans stand on a more narrow base in less stable and less predictable conditions. If these conditions should change so as to make a departmental plan essentially unrealistic and unmanageable, there is no point in stubbornly maintaining that plan, and it should be revised. It should be emphasized, though, that the general courses and objectives developed in the early planning steps should almost never be changed. Deficiencies created by re-


One school of thought holds the operating plan sacred; the other permits ready revision. Neither is totally right or wrong; there is a middle ground.

vising one departmental plan must be made up in another. Any proposed revision should go through the same review and approval process as the original plan.

An efficiently functioning reporting system matched to a properly developed operating plan makes it possible to reward effective performance. The base for measurement is established in the plan. For each manager and executive it is the carefully considered, attainable, and expected result of his managerial activity. It is the agreement between him and his employer as to what he can do with what he has to work with. The means of measurement are provided in the performance reporting program. Judgment is still required because there are some important elements of managerial performance that can never be precisely quantified, but a plan takes a great deal of the guesswork out of the evaluation of executive performance. Use of the profit plan as a determinant of compensation and promotion has been found to be an effective incentive to improve both future performance and the quality of planning for the future.

The steps in profit planning are summarized in Table 2 on page 18.

### *Results*

For some organizations management by plan may be rather strong medicine. In a company accustomed to management by instinct, management by indifference, or management by crisis, a change to management by planned performance may be initially unpleasant. But the benefits are substantial, for the company and its employees and shareholders, for management people, and for the chief executive.

It is a truism that careful planning and adequate control are more necessary for business success today than ever before. This truism is based on two incontrovertible facts:

One is that the complexity of present-day operations makes intuitive management impossible. Producers of goods and services alike are now ranging through markets that they only began to approach a few years ago. Manufacturers are producing an array of products unheard of in the last decade. Countless new production tools and techniques are available. Faced with complicated and changing conditions, no company can rely wholly on its past, its experience, and its traditional ways. It must have a set of clear-cut objectives and clear ideas of how to achieve them.

The second reason why planning and control are so necessary is that decision times have become very short. Major decisions are now made in days or even hours, with no time to gather new information, to survey and assess the situation. The executive must know his objectives and his present position precisely and continuously in order to see how his decision is likely to improve or impede his progress toward those planned objectives.

Through the comprehensive planning and review process, the chief executive effectively determines company policy. The planning and review procedure makes it possible for him to communicate his objectives and policies easily and clearly, with a minimum possibility of misunderstanding or intentional or unintentional misinterpretation. Not only is it easier for him to communicate his ideas in the framework of a coherent plan; it is also easier for him to persuade others to action, because he can show graphically and effectively the reason for each planned action, its relation to other parts of the plan, its expected effect, and the possible consequence of nonperformance. He sets attainable performance targets in measurable quantities. And the plan completes his control capability by furnishing a solid base for his evaluation of the performance of his people and the effect of his policies.

Finally, a few months of successful operation under a functioning profit plan will give the chief executive and all of the management group a sense of solid confidence in their own abilities to plan and manage. With this confidence come the encouragement and the freedom to exploit to fullest advantage the present capability and the future potential of their company.

: Management Services, Vol. 1, No. 4, September-October 1964 [whole issue]

# SALES-PRODUCTION COORDINATION THROUGH MATHEMATICAL PROGRAMING

*The more products a company has the more difficult it is to pick the most profitable combination of product quantities and production facilities. The solution may lie in the use of mathematical techniques.*

*by Norbert Lloyd Enrick*
*University of Virginia*

FOR ANY company that manufactures more than one product, the choice of a product mix requires careful balancing of anticipated costs and revenues. An analysis whose principal emphasis is on production costs may fail to take into account all the intricacies of sales forecasting and price variability. Or, more commonly, a sales-oriented analysis based on sales potential and unit profit margin may neglect the effect that various combinations of machines and facilities can have on costs.

This article is adapted from chapters of Dr. Enrick's book, *Management Operations Research,* which will be published by Holt, Rinehart & Winston, Inc., in the fall of 1964.

Sometimes a product that seems to have a good profit margin may be relatively uneconomical to produce in large quantities because its production requirements create bottlenecks in a department or on a critical machine, thereby disproportionately limiting the production of other products. In such a case, production of apparently lower-margin products may contribute more to over-all profits.

When a wide variety of products, models, styles, machines, and production facilities is involved, the calculation of the combination of products and quantities that will yield the maximum over-all profit can be a complex task. Fortunately, new mathematical techniques are available that can greatly simplify the work, particularly when they are used in combination with electronic computers. This article describes how one of these techniques, mathematical programing, can be utilized to coordinate product and production planning.

### *Mathematics vs. intuition*

Often the results obtained from mathematical analysis are quite different from those that would probably emerge from a more intuitive form of decision making. Take the case illustrated in Table 1 on page 22. (For the sake of simplicity, the 40 products actually manufactured by this electronic component

TABLE 1

Unit Profits and Production Requirements For Four Products

| | Marketable Products | | | | Normal Productive Capacity, hr/wk |
|---|---|---|---|---|---|
| | A | B | C | D | |
| a. Profit, $/piece | 0.40 | 0.37 | 0.36 | 0.28 | |
| b. Production time requirements, hr/1000 pieces | | | | | |
| Machining | 30.6 | 30.6 | 32.6 | 22.4 | 250 |
| Coil winding | 72.0 | 64.8 | 72.0 | 79.2 | 720 |
| Mounting | 36.0 | 28.8 | 28.8 | 21.6 | 242 |
| Testing | 18.0 | 26.0 | 24.0 | 29.0 | 260 |

producer and the one dozen processing stages actually used have been reduced in the table to four products, A, B, C, and D, and to four processing stages, machining, coil winding, mounting, and testing.) Table 1 shows the unit profit normally associated with each product, the normal productive capacity of each production department, and the production time requirements in each department for each product.

To the sales manager the choice of the product to be emphasized was obvious. "You can see," he pointed out, "that we make the greatest profit on Product A and the lowest profit on Product D. We don't need mathematics to show us the most desirable products to sell. Our problem is that people won't buy much of A."

The production manager, on the other hand, felt that some weight ought to be given to production balance. Despite its high unit profit, Product A had the disadvantage of requiring a relatively long time for mounting. Thus, it was likely to create a bottleneck in the mounting department, which would leave other machines idle while mounting was unable to meet the demands on it. The cost of this production imbalance could easily cancel out a good share of Product A's normal profit margin.

The pertinent data were put into linear equations and a computer was put to work calculating which products in which quantities would result in maximum over-all profit for the company. The answer: 5,220 pieces a week of Product D, 3,790 pieces of Product B, 560 of Product A, and none of Product C. This combination would produce a total weekly profit of $3,088, higher than any other possible product combination, and would utilize the full productive capacity of every processing department except coil winding, where there would be a small but unavoidable under-utilization of 21 machine-hours a week.

The results were a surprise to the sales manager. Product A, which he had been trying to promote so vigorously, turned out to be a poor contributor to over-all profit, and Product D, with the lowest unit profit, was shown to be the greatest contributor.

In the actual analysis, which included 40 products, company management gained a completely new perspective on its marketable products. Many past favorites lost out against previously overlooked items. As a result, the company was able to direct its sales and promotional efforts much more intelligently and decisively. In addition, plant morale was improved and costs reduced through better balanced production, more even flow of work, and less use of overtime and part-time workers.

### *Mathematical programing*

The company's conclusions about its product mix were reached by means of mathematical programing, a mathematical method of analyzing inter-related variables to determine the optimum combination. The required formulas are not particularly difficult to set up; their solution, tedious and time-consuming by manual methods, takes even a relatively small computer only a few minutes, even if a large number of variables are involved.

A large-scale problem, of course, can involve a staggering number of factors. In a large company several thousand products may be consid-

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ered. A variety of market factors may be included in the problem, among them price-demand relationships, minimum product quantities for a complete line, maximum limits on marketability of specific products, long-term sales contracts limiting production capacity, and the extent of production for inventory in slack periods. The production side of the analysis may include a large number of processing departments—or even particular machine groups or machine types. For each processing department or machine the variables may include such factors as machine time, labor time, maintenance time, raw materials and supplies used, and skilled personnel needed. Other considerations may be introduced, such as whether to make or buy parts or completed components and assemblies, the desirability of new equipment purchases, the profitability of discount sales to large customers, and various alternative production or sales programs.

Such analyses can be used to aid management decision making in many areas. The following list includes only a few examples:

1. Considering the installation of new equipment because of limits on over-all plant capacity
2. Planning to increase or trim managerial, administrative, staff, and operating personnel where either course appears desirable
3. Long-range planning to deal with anticipated technological and market developments
4. Integrating a variety of other tools for quantitative analysis and control

To illustrate how mathematical programing is applied, let us take a simplified example involving only linear factor combinations and variables (hence suitable for linear programing) and involving only two products (hence capable of being expressed graphically). This problem is based on a consulting engagement for a manufacturer of small metal parts.

Data concerning the two products, A and B, and the two most critical processing departments, polishing and plating, are given in Table 2 on this page. These include production rates and expected returns in terms of dollar contribution based on prices and market conditions. Contribution represents price less variable manufacturing cost. Variable manufacturing cost excludes fixed and selling costs.

At current prices Product A brings the higher contribution per gross. Theoretically, there is capacity to polish 40 gross of Product A weekly, but, because there is plating capacity for only 20 gross of Product A per week, plating is a bottleneck. B's bottleneck is in polishing.

From Line d it is apparent that if only Product A is manufactured, production of 20 gross at $6 per gross profit contribution will result in a total weekly profit contribution of $120. If Product B is manufactured instead, production of 30 gross at $5 per gross profit contribution will result in a higher total profit contribution, $150 a week. The fact that the two products have different bottlenecks suggests that a combination of the two products should be produced.

TABLE 2

Simplex Programing Problem

| | Marketable Products | | Productive Capacity | |
|---|---|---|---|---|
| | A | B | hr/wk | Total |
| a. Contribution, $/gross | 6.00 | 5.00 | | |
| b. Production time requirements, hr/gross | | | | |
| Polishing | 3 | 4 | 120 | |
| Plating | 2 | 1 | 40 | |
| c. Output if only Product A or Product B, but not both, are produced, gross/wk. | | | | |
| Polishing* | (40) | 30** | | |
| Plating | 20** | (40) | | |
| d. Contribution from output in (c), found by multiplying (a) x (c), $/wk. | 120 | 150 | 150*** | |

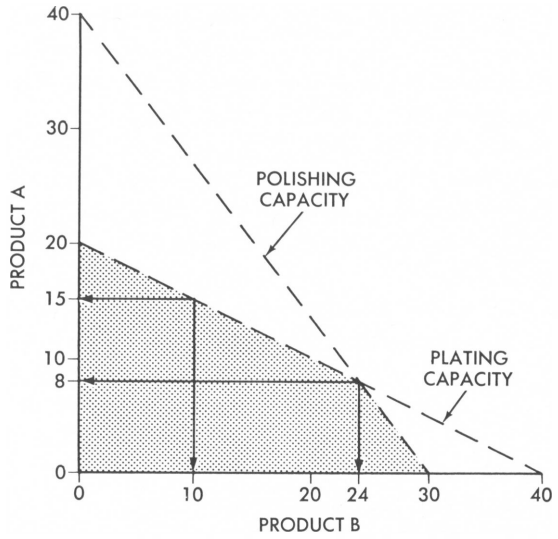
*Productive capacity divided by requirements in line b. Thus 120/3 = 40. Since only 20 gross can be plated, the 40 gross in polishing cannot be utilized beyond the plating bottleneck, and is therefore shown in parentheses.

**Bottleneck process for this product (A or B)

***Only Product A or Product B, but not both can be produced at this stage, so that the maximum contribution equals the highest contribution product, which is Product B at $150.

FIGURE 1

Production Capacities for Two Products




In this graphic presentation of the simplest programing example, the shaded area represents feasible production quantities of Products A and B. Beyond this area, bottlenecks in polishing and plating prevent further production.

The optimum product combination may be determined by graphing the possible quantities of Product A on one axis and Product B on the other, as in Figure 1 on this page. The capacity if only Product A is polished (40 on the A axis) is connected by a line with the capacity if only Product B is polished (30 on the B axis). Similarly, plating capacity for Product A (20 on the A axis) is connected with plating capacity for Product B (40 on the B axis). The shaded portion of the graph represents feasible product combinations. For example, if 10 gross of B and 15 gross of A are produced, available plating capacity is exhausted. If 24 gross of B and 8 gross of A are produced, both plating and polishing capacities are exhausted.

### *Third dimension*

The data in Figure 1 may also be shown as in Figure 2 on this page, a three-dimensional form that permits addition of a new variable, the profit contribution associated with the various product combinations.

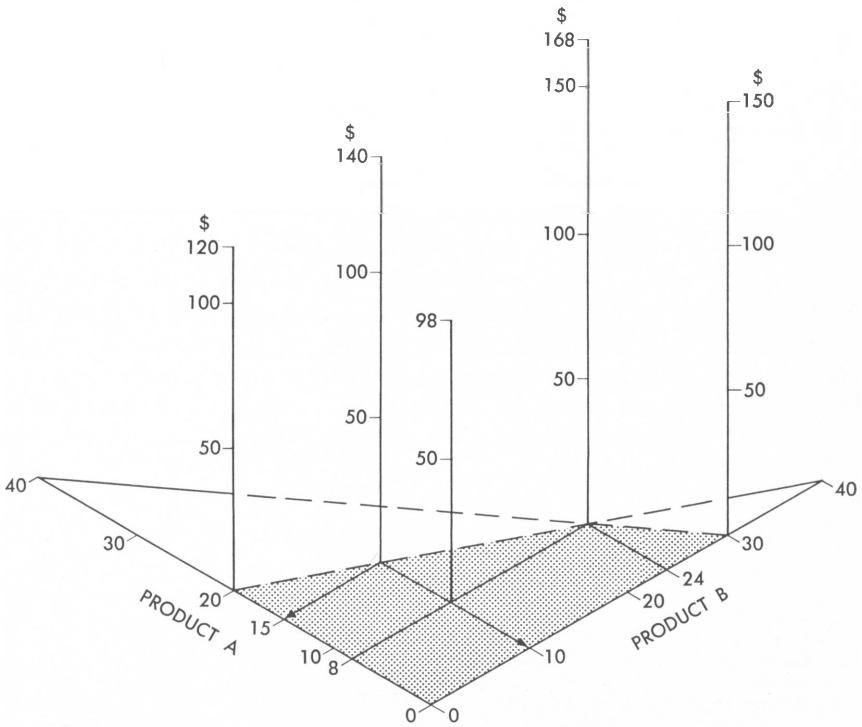
For the previously mentioned 15 gross of Product A and 10 gross of Product B, the total product contribution will be 15 times $6 plus 10 times $5, or $140. This amount is higher than the $120 for A alone but less than the $150 for B alone. If we produce, say, 8 gross of A and 10 of B, we will not be using all our capacity, and contribution will be only $98 a week (8 times $6 plus 10 times $5).

The trend of the heights of the dollar columns in Figure 2 leads us to try the intersection point of the polishing and plating capacity, which corresponds to 8 gross of A and 24 gross of B, with a total profit contribution of $168 ($6 times 8 plus $5 times 24). Any movement away from this product combination yields lower total returns, as is shown in Figure 3 on page 25.

This simplified problem illustrates an important principle, valid for all mathematical programing with linear relationships: To find the

FIGURE 2

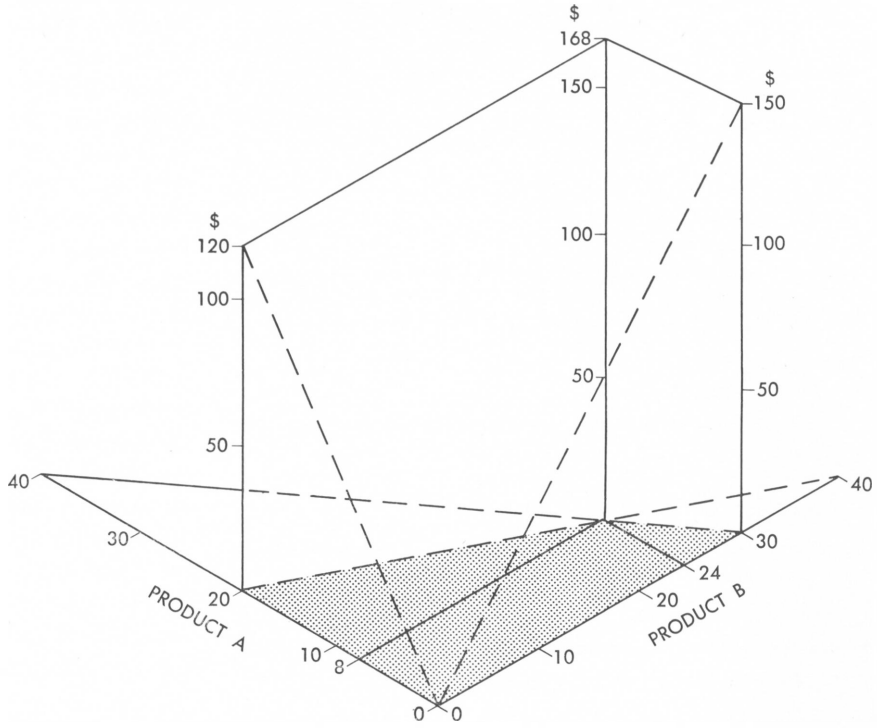
Production Capacities and Profit Contributions




In this three-dimensional representation, typical examples of various contributions from different quantities of Products A and B are shown: If 20 gross of A only are produced, contribution is 20 x $6 = $120. Producing 15 gross of A and 10 of B yields $140 (15 x $6 + 10 x $5).

FIGURE 3

Optimum Product Combination




Evaluation of the four corners of the base leads to discovery of the highest contribution. The first corner, 0 production, yields $0. The second corner, 20 units of Product A at $6 per unit, yields $120; the opposite corner, 30 units of Product B at $5 per unit, yields $150. The farthest corner, for 8 units of A and 24 units of B, yields the maximum of $168 (8 x $6 + 24 x $5).

maximum, investigate the corners. By analyzing the points 0, 20, 30, and the intersection of the two capacity lines, we have not only succeeded in constructing the dollar contribution dimension but also have found the optimum point.

Maximum profit does not always involve a combination of products, of course. For example, if Product A's contribution had been $11, then production of 20 gross of A would have resulted in a total profit contribution of $220, as against only $208 from 8 gross of A (8 times $11) plus 24 gross of B (24 times $5).

The principle of investigating corners is crucial to solving the type of problem described here. It is applicable for all linear relationships of products and returns, no matter how many products are involved. However, with each product we add a dimension to the space structure to be investigated. Two products require three dimensions; three products need four dimensions; and ten products need eleven dimensions. Since humans have the ability to conceive only three-dimensional space, it is necessary to resort to mathematical investigation of corners in many-dimensional space.

### *Matrix method*

In actual practice, of course, few choices of product mix are simple enough to be expressed graphically. Such problems nearly always require matrix algebra, whether the solutions are obtained manually or with a computer. This technique will now be illustrated, using the same data previously presented for the polishing-plating contractor.

These data can be put into equations showing the objective of management and the controlling factors. The procedure is demonstrated in Table 3 on page 26. There the equations are expressed in symmetrical form suitable for transfer into a block of numbers known as a matrix, as shown in Table 4 on page 26. When the data are in matrix form, it is possible to solve for the optimum, following the matrix steps explained under the tables.

The first matrix shows that if only the two imaginary products M and N are produced (in quantities of 120 and 40, respectively, as indicated in the results column), profit (Z) as expected will be zero. This first solution then represents the zero point of the diagram in Figure 3. The evaluation row Z-P also contains negative entries, meaning that we are far removed from the optimum. A second matrix must be investigated, as in Table 5 on page 29, using the transformation procedure of Figure 4 on page 27.

This new matrix tests production of 60 gross of imaginary Product M and 20 gross of actual Product A, with a profit of $120. This result corresponds with the finding at the A side of the structure in Figure 3. The matrix has investigated the corner represented by the Product A line and the plating capacity line at the base. However, since Z-P is negative for Column B of the matrix, we are not yet at optimum.

The third and final matrix, shown in Table 6 on page 29, yields the optimum solution of $168 for 24

TABLE 3

Equations of Production and Profit-Optimizing Relationships

1. Objective Equation

The over-all objective is to maximize dollar profit, Z. Since Product A has a profit of $6 per gross and Product B has a profit of $5 per gross, maximum profit will result from producing that quantity A for Product A and that quantity B of Product B which yields the highest Z; or:

$$6A + 5B = Z \qquad \text{Eq. 1}$$

2. Production Equations

Production of Products A and B is limited by the capacity of 120 hours per week in polishing and 40 hours in plating. At the production rates shown in Table 2, therefore, the quantities A and B of Products A and B that can be produced are:

a. In polishing: $3A + 4B \leqq 120$ Eq. 2

b. In plating: $2A + 1B \leqq 40$ Eq. 3

The sign $\leqq$ means "equal to or smaller than," indicating that production cannot exceed capacity.

3. Symmetrical Equations

The inequality signs in equations 2 and 3 are messy. But we can convert them to equal signs, by adding proper but as yet unknown magnitudes to the left-hand side of each equation. These magnitudes are known as "imaginary variables" representing imaginary production (of zero or greater quantity). Using "M" and "N" for these imaginaries and inserting zero values as shown below, we obtain symmetrical equations for the three expressions above:

$$6A + 5B + 0M + 0N = Z \qquad \text{Eq. 1a}$$

$$3A + 4B + 1M + 0N = 120 \qquad \text{Eq. 2a}$$

$$2A + 1B + 0M + 1N = 40 \qquad \text{Eq. 3a}$$

4. Solving for the Optimum

The equations 1a to 3a can now be re-written in a block of numbers or matrix (Table 4), which is convenient for solving them for the optimum profit, Z, sought.

TABLE 4

First Matrix

| Row | Profit P | Products A | B | M | N | Result R | Evaluation R/A | Key Row |
|---|---|---|---|---|---|---|---|---|
| P | | 6 | 5 | 0 | 0 | | | |
| M | 0 | 3 | 4 | 1 | 0 | 120 | 120/3 = 40 | |
| N | 0 | 2 | 1 | 0 | 1 | 40 | 40/2 = 20 | √ |
| Z | | 0 | 0 | 0 | 0 | 0 | | |
| Z-P | | −6 | −5 | 0 | 0 | | | |
| Key Column | √ | | | | | | | |

1. Columns A to R show the numerical coefficients of equations 1a to 3a for rows P to M. Column P shows the zero profits associated with the imaginary products M and N.
2. Row Z is the sum of the product quantities multiplied by their profits. For column A, 3 x 0 plus 2 x 0 totals 0.
3. Row Z-P is found by subtracting each entry in row P from row Z. Unless Z-P contains non-negative entries in all columns, maximum profit has not been reached. In fact, column R shows that when 120 units of imaginary Product M and 40 units of imaginary Product N are produced, profit will be zero (row Z).
4. The key column is A, since it contains the lowest Z-P. By dividing each entry under R by its corresponding A, R/A is obtained. In row M, R is 120 and A is 3, so that R/A is 120/3 or 40. The key row is N, since it contains the lowest R/A.
5. The intersection of key column and key row is the intersection of A and N, which yields the pivot entry, 2. This pivot, representing the lowest Z-P and the lowest R/A, is the basing point, from which a new matrix is formed next. This new matrix will seek to increase profits, until maximum profit is reached by successive "iterations" or matrix steps.

gross of B and 8 gross of A, corresponding with the structure in Figure 3. This is the maximum profit obtainable.

For the two-product case illustrated here, the matrix method has little value. It is more rapid than trial and error and sometimes gives a more exact answer than can be read from a graph. But the real advantage of this method is that the matrix can easily be expanded to cover any number of products.

With a multiplicity of products the graphic method would fail and the trial and error approach would require a lifetime. Matrix algebra has neither disadvantage. To consider additional products, C and D, for example, it is necessary only to invent two other imaginary products, say, K and L, add corresponding columns and rows to the first matrix, and start the matrix procedure rolling. After several iterations the matrix that contains the solution will be reached.

### *Profitability analysis*

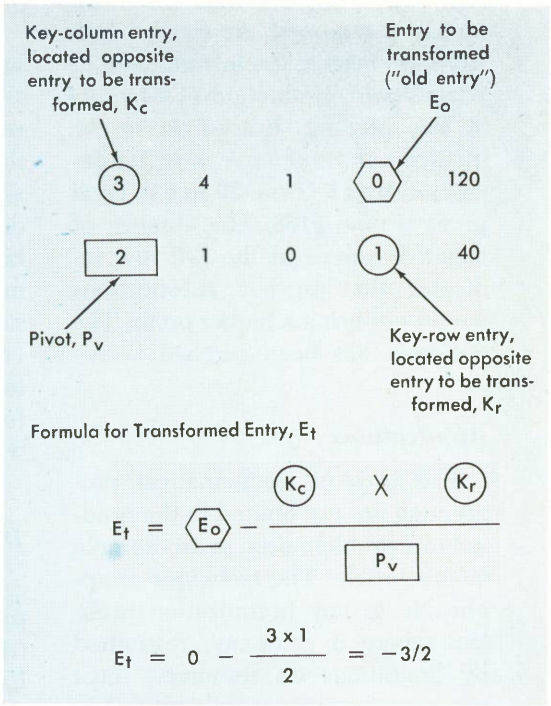
Linear programing provides a means of examining the relative profitability of various alternative production schedules. The method can be illustrated with the data previously presented for the polishing-plating contractor.

The first matrix, in Table 4, represents the equations 1a to 3a of Table 3. The matrix shows that if only Products M and N (the imaginary products) are manufactured, in quantities of 120 and 40 units, respectively, capacity will be exhausted. But total profit will be zero. This is the least desirable position, from which one must look around to see what changes will produce better results.

The first step is to examine the entries in Rows M and N. The first entry in Row M under Column A is 3. This figure means in effect: If you wish to polish one unit of Product A, you must give up three hours of the imaginary Product M to obtain the requisite capacity. The adjoining entry calls for the surrender of four hours of M to obtain one

FIGURE 4

Matrix Transformation Method




This is the method of matrix transformation illustrated for one of the entries in the First Matrix. The entire part of the matrix to be transformed, with key row and column, is shown above.

unit of B. The entry 1 under Column M indicates that M is a substitute for itself, that is, that for each unit of M to be added an old unit of M must be dropped. No production of M need be given up to polish an additional unit of N because N does not need polishing; this explains the zero in the N column. The next row, N, may be analyzed in the same manner, this time for the plating process.

Row Z-P gives, for each product, the per-unit loss resulting if the product is not made. For example, $6 is lost for each unit of Product A that is not produced. Since this product shows the highest loss per unit, some amount of Products M and N should be replaced with some quantity of Product A. But how much?

The proper quantity of A may be found from the evaluation column. It shows that 40 units of A can be polished but only 20 can be plated. Plating is the bottleneck process for Product A.

We might investigate the effect of producing 20 units of A. Since this production exhausts plating capacity, we know that Product A replaces N. Therefore, we must substitute A for N in the matrix and insert the unit profit of $6 in the profit column. First, however, each new entry for the product and results columns must be divided by the pivot 2 before insertion. Because 2 hours of Product N must be given up for each unit of Product A added, the substitution of A for N means a change in the quantities of all entries by the ratio ½. This value also may be interpreted as the rate at which each unit of A is substituted for (the two units of) Product N.

Unlike Product N, Product A needs polishing. To permit this polishing Product M must be reduced. The formula in Figure 4 shows the amounts involved. This formula again represents a substitution, but this time there is a subtraction: The corresponding key-row entry is adjusted for the substitution factor (in this case, multiplied by ½), and the resultant value is multiplied by the quantity shown by the key-column entry. The amount thus subtracted shows how much of Product M must be given up to produce the 20 units of Product A.

Take the results column as an example: For Row M the transformation is 120 minus (3 times 40/2). The 120 represents time now used in producing Product M. The ratio 40/2 represents the 20 units of Product A to be produced, and the 3 represents the units of Product M that must be given up for each unit of Product A that is polished. Thus, 3 times 20 is 60, which is subtracted from 120 to give the entry 60 found in the second matrix.

### *Optimum contribution*

The effect of substituting A for N in the second matrix is an increase in total profit from zero to $120. But we are not yet at a maximum. Imaginary Product M is using so much productive capacity that it causes a loss of $2 per unit of potential production of Product B. At least one more matrix is needed. Again the key column and row are deter-

mined, the pivot is found, a substitution is made (this time Row M is replaced with B), and the third matrix is obtained. As can be seen from the matrix, the introduction of B results in production of 24 units of this product. But to do so the quantity of Product A must be decreased by 12 (from 20 to 8). Total profit is now $168. The absence of negative values in the Z-P row indicates that further substitutions would not bring a higher profit. The optimum has been reached.

### *Applications*

The uses of mathematical programing are not limited to the product mix problem used as an example in this article. The technique is applicable to any optimization problem where a company, restrained by limitations on resources, must choose among many possible courses of action in such a way as to minimize costs or maximize revenues.

***Mathematical programing has many uses besides product mix analysis. It is applicable to any problem of optimization where limited resources must be allocated in such a way as to minimize costs or maximize revenues.***

Some companies utilize mathematical programing in continuing computer decision-making systems. For the most part these systems cover functional areas of the company, such as distribution, advertising, or product processing — rather than over-all corporate strategy.

### *Product blending*

Product blending in a process industry is one of the best known examples. Animal feed mixes, for example, must supply certain minimum daily requirements of basic vitamins, minerals, and other dietary elements to meet standards set by the U. S. Department of Agriculture. These requirements may be met by many possible combinations of such ingredients as corn, wheat, meat scraps, and soy beans. At any given time only one combination of ingredients will both conform to all specifications and minimize costs. Yet the optimum combination may change every time the price of one of the ingredients changes. Thus, feed producers have found it economical to set up operating systems by which computers regularly calculate new optimums based on new cost data.

Similarly, the oil industry has been among the earliest and heaviest users of linear programing. Many refineries have computers guiding the blending of fuel oil, gasoline, and other products to produce standard products at minimum cost. A large textile mill group uses mathematical programing to blend rawstock fibers in various proportions (by fiber characteristics) to obtain fabrics of high strength and uniformity at the lowest cost consistent with these quality requirements.

### *Distribution costs*

Linear programing has also proved effective in minimizing distribution costs. Many companies have several plants and warehouses throughout the country to meet local consumer demand and provide temporary storage. The problem is which products to ship from which plants to which warehouses so as to minimize shipping and storage costs while at the same time meeting expected consumer demand. H. J. Heinz Company worked out a system for its plant-to-warehouse distribution. A computer, using mathematical programing, calculates an optimal schedule each week, saving many thousands of shipping dollars that might be wasted by rule-of-thumb allocations.

Operating systems based on mathematical programing are normally economical only for large companies —or for not so large companies in industries where prices of finished products or raw materials change frequently. Even a small company, however, can use the technique for occasional profitability analyses when a need arises to reallocate resources. Computer time can be rented from outside sources, or, if the problem can be simplified sufficiently, the equations can be solved manually.

Financial institutions have used mathematical programing to analyze their investment portfolios. Here the objective is to maximize

yield while staying within strict limitations on maturity years for various groups of securities and other risk factors.

### *Media selection*

The technique also has been applied to the selection of advertising media. Here the problem is to select an optimal combination, from a great variety of alternative media, that fits within a limited budget but is consistent with sales estimates and marketing uncertainties. The results, as in all marketing applications, have been less clearly successful than in production because of the uncertain validity of the data available and of the assumptions used in structuring the problem.

A space company has worked out a method for optimal assignment of candidates with varying qualifications to highly demanding tasks, such as space program missions. Given the proficiencies and other qualifications of each candidate and the anticipated demands of each task, mathematical programing can be used to find that combination of men and tasks that would maximize the likelihood of success of the mission.

### *Conclusion*

Mathematical programing is an effective technique for evaluating the cost and revenue effects of varying combinations of inter-related restricted alternatives. Thus, it can point the way to an optimal course of action.

Like all operations research techniques, however, mathematical programing does not provide final answers. Properly used, it can improve management's batting average in decision making. But its results can never be used as rigid directives, only as guides to an initial course continually subject to revision and adaptation based on new experience and evidence. Such a dynamic managerial process is in itself an optimum-oriented approach, continually enhancing the quality of planning, decision making, and control.

TABLE 5
Second Matrix

| Row | Profit P | Product Columns A | B | M | N | Result R | Evaluation R/B |
|---|---|---|---|---|---|---|---|
| P | | 6 | 5 | 0 | 0 | | |
| M | 0 | 0 | 5/2 | 1 | −3/2 | 60 | 60/(5/2)=24 |
| A | 6 | 1 | 1/2 | 0 | 1/2 | 20 | 20/(1/2)=40 |
| Z | | 6 | 3 | 0 | 3 | 120 | |
| Z-P | | 0 | −2 | 0 | 3 | | |

1. Row M, columns B to R, is obtained from row M of the first matrix, using the transformation method shown in Figure 4. Column A, containing the pivot, becomes 0 for all product rows excepting the pivot row, where it becomes 1.
2. The other entries in row A are found from row N of the first matrix, by dividing each value in row N, from column A to R, by the pivot value, 2. Under column P, the unit-profit of $6 for Product A is shown.
3. Rows Z and Z-P are found from the steps previously shown for the first matrix. For column B, for example, Z = (5/2 x 0) + (1/2 x 6) = 3. Next, 3 minus 5 = −2.
4. The lowest Z-P entry is −2 under column B, which is therefore the new key column. Evaluating the ratio R/B for rows M and A, we find the new key row, M, corresponding to the lowest value of the ratio. At the intersection of new key column M and new key row A is the entry 5/2, which is the new pivot.
5. Although the present matrix yields a profit of $120, based on production of 60 units of Product M and 20 units of Product A (column R, rows Z, M, and A, respectively), this is not the maximum profit obtainable, since there is a negative value in the Z-P row. A third matrix must be formed, using the new pivot of 5/2.

TABLE 6
Third Matrix

| Row | Profit P | A | B | M | N | Result R |
|---|---|---|---|---|---|---|
| P | | 6 | 5 | 0 | 0 | |
| B | 5 | 0 | 1 | 2/5 | −1/5 | 24 |
| A | 6 | 1 | 0 | −1/5 | 1/5 | 8 |
| Z | | 6 | 5 | 0.80 | 0.20 | 168 |
| Z-P | | 0 | 0 | 0.80 | 0.20 | |

1. Row B, columns A to R, is obtained from M of the preceding matrix by dividing each entry in row M by the pivot value 5/2.
2. Rows A, Z, and Z-P are found from the second matrix, using the transformation steps previously shown.
3. There are no negative values in the Z-P row. Therefore the profit of $168 shown is the maximum attainable. No further matrix will be needed. By producing 24 units of Product B and 8 units of Product A (column R, rows B and A), the $168 optimum profit results.


*Prices are just as important as costs in improving company profitability. Yet much less attention has been given to their control. These authors have a system, analogous to standard costs, to propose:*

# STANDARD SALES PRICES AND THEIR VARIANCES

*The Ohio State University*
*&*
*Norman E. Dittrich*
*University of Wisconsin*
*by Felix P. Kollaritsch*

We've all read a thousand times that even a small reduction in operating costs is the equivalent—in the total profit picture—of a very large increase in sales. This is certainly true. But it does not alter the fact that an increase in dollar volume can make a major contribution to profit.

There is one exception, of course. The company that offers varying prices for the same product, through such devices as cash and quantity discounts, may find itself in a situation where dollar volume of sales is rising but profits are not keeping pace or are even falling because the margin of profit per sale is narrowing.

It is unfortunate that, basic as the sales function is, performance measurement and control in the area of sales revenue have been much less well developed than have performance measurement and control in the area of cost. Many business accounting systems do not provide the data needed to measure sales revenue results and take corrective action.

Failure to develop adequate control in the area of sales revenue is often explained, somewhat glibly, by the contention that sales transactions are inherently less controllable than cost transactions because the company typically exercises a greater degree of contractual initiative when dealing with suppliers and employees than when dealing with customers. There is undoubtedly some validity to this contention. That is no argument against making the effort, however. Indeed, it simply lends additional support to the precept that whatever means of control over sales transactions are available should be as thoroughly

developed and as fully exploited as possible.

This article suggests the use of a standard sales price, which could be formulated and used in much the same way as a standard cost system in manufacturing operations. The establishment of such a system would permit the determination of variances between actual and standard sales prices.

Such an approach is appropriate, of course, only for a company that employs flexible pricing. Its feasibility depends upon the relative stability of pertinent market factors applicable to the company or industry. Even within these limitations, however, there are many companies whose operating situations would readily permit this approach to sales price variance control. Very few now use any such method.

A standard sales price system is outlined in general terms in this article. The need for and usefulness of accounting for sales price variances are analyzed, with emphasis on the areas of control and decision making. Implementation procedures are proposed and compared with possible alternative procedures.

### *Standard price system*

Standard sales prices are predetermined prices based on anticipated attainable future prices.[1] The establishment of these prices is already necessary for general planning, financial budgeting, profit forecasting, and the like. Extending their use to compute a current sales price variance would therefore involve only a negligible incremental cost of recording related sales price variances.

[1]List prices might be used as standard sales prices. Since companies with flexible pricing expect prices to average below list, this would call for a "planned" unfavorable price variance. However, "planned" variances, which are usually based on average deviations for large numbers of transactions, are more properly applied in aggregate analyses than in determining the extent and cause of variances associated with a specific sale. It might be better, therefore, to use a more realistic price as a standard.

When the number of products is large, this calculation can be performed most easily by computer. It would seem reasonable to assume that most companies with many products (1) already have—or will soon obtain—computers, (2) already detail their sales data, and (3) have sufficient unused computer time. Under some circumstances the implementation of a limited sales price system might still be justified even if all of these conditions did not exist.

The computer would be programed to carry the standard prices of products. As the actual prices and quantities from sales invoices were put into the computer, each actual sales price and standard sales price would be compared and the difference multiplied by the quantities involved in the specific sale. This would measure the sales price variance in dollars, an amount which would be stored in a sales price variance account. The entry below, in general journal form, demonstrates the accounting mechanics involved:

| | Debit | Credit |
|---|---|---|
| Accounts Receivable ..... | $100,000 | |
| Sales Price Variance ..... | 10,000 | |
| Sales ..... | | $110,000 |

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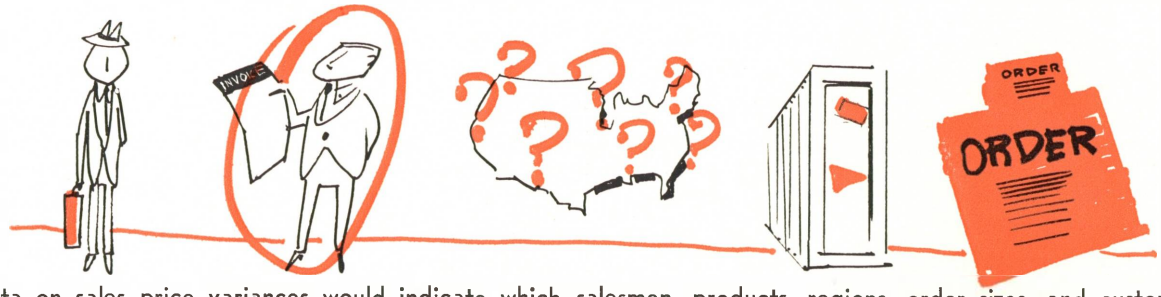
Only one additional account would be needed in the general ledger—the sales price variance control account. This total net sales price variance could be detailed into any number of subvariances, such as promotional concessions, quantity concessions, and special order (private label, etc.) concessions. The extent to which the total net sales price variance would be analyzed would be limited only by the justifiable need for such information. The sales account would show at any time total sales at standard sales prices. The sales price variance account would show the net aggregate variance between sales at standard prices and sales at actual prices. For internal reporting purposes, the sales price variance account should be treated as a contra-account. For external reporting purposes, this account would be closed to the sales account, thereby reducing the latter to an amount equal to sales at actual prices.

The sales price variance data could be maintained on a memoranda basis; under certain conditions, such as small-scale operations or test implementations, the use of memoranda might even be desirable. However, in most cases, the advantages of integrating the sales price variance system into the general ledger would be considerable. Typically, sales revenue is recorded virtually at the time the sale takes place; consequently, if the sales price variance system is incorporated into the general ledger, sales price variances would be recorded promptly at the time of sale and prompt investigation and remedial action on the part of management would be possible.

### *Additional uses*

When, as is the case with many companies, the card or tape includes information related to salesman, customer, geographic location, product, order size, etc., additional analyses on these bases should provide useful information. For instance, this system could indicate which salesmen exercise




Data on sales price variances would indicate which salesmen, products, regions, order sizes, and customer groups were responsible for sales below standard prices: information on which corrective action could be based.

the most liberal price policies; which products appear to be depressed; whether such products are depressed on a local, regional, or national basis; on what size of order, or with which customer group, prices seem to be most sensitive; etc. As was indicated earlier, the detailed analysis of the information generated by this refinement in recording sales revenues could be materially extended in scope, with the consideration, of course, that for any given extension the potential savings must justify the related cost of analysis and investigation.

A further advantage of this system of recording sales price variances is that, since it highlights only the deviations from plan, it operates in accordance with the principle of "management by exception." This system would eliminate unnecessary routine testing and investigation of sales transactions that are materially in agreement with plan or specification. As with any variance analysis, *prompt* investigation of *relevant* factors is always necessary for optimal results.

Because values and objectives typically change under varying circumstances, certain assumptions are usually necessary prerequisites to framing the limitations under which a given analysis and its related conclusions will be worthwhile. In this instance, it is only necessary to acknowledge the primary importance of a reasonable profit to perpetuation of the firm and the critical role that sales revenue plays in determining profits. It is obvious that fluctuations in sales price can be expected to influence the extent to which a given profit margin is attained.[2] Price fluctuations will directly and/or indirectly influence profits through larger or smaller margins, expanded or contracted volumes, increased or decreased costs, or any combination of changes in these factors. Simply stated, this means that sales price fluctuations, as well as cost fluctuations, potentially change profits. Since such extreme importance has been attached to controlling manufacturing costs by establishing norms for this function and measuring deviations therefrom, logic demands comparable efforts directed toward controlling sales prices.

### *Importance of price*

There is a simple, but often overlooked, characteristic of sales price that makes it, from one facet at least, more important than cost in determining profit margin. This characteristic is that, for all profitable operations, sales price is, by some margin, absolutely greater than total costs and typically exceeds in amount by a substantial margin any one cost factor. This means that a specific proportional change in sales price will, in all cases, have a greater effect on profit than will corresponding changes either in total cost or in any one

[2]Deviations in sales volume and product mix can also have important effects on profits, of course. No effort was made to consider these factors, which were deemed sufficiently challenging to warrant separate analyses.

cost factor.[3] The table below illustrates this subtle characteristic of sales price.

The revenue and cost proportions used in the assumed operating base (Column 1) probably fall within a range representative of many firms. Column 2 shows the effect on profit margin of a 5 per cent unfavorable change in direct labor costs. Column 3 shows the effect on profit margin of a 5 per cent unfavorable change in direct materials costs. Column 4 shows the effect on profit margin of a 5 per cent unfavorable change in sales price. It can be seen from the chart that any given proportional change in sales price will have a greater absolute effect on profit margin than will a comparable change in any one cost factor or even in total costs. This intrinsic characteristic of sales price certainly supports the idea that sales prices should be subject to as much control effort as costs, if not more. Volume, prices, costs, and profit margins are so closely interrelated that any accounting system not providing for control of all of these factors should be questioned.

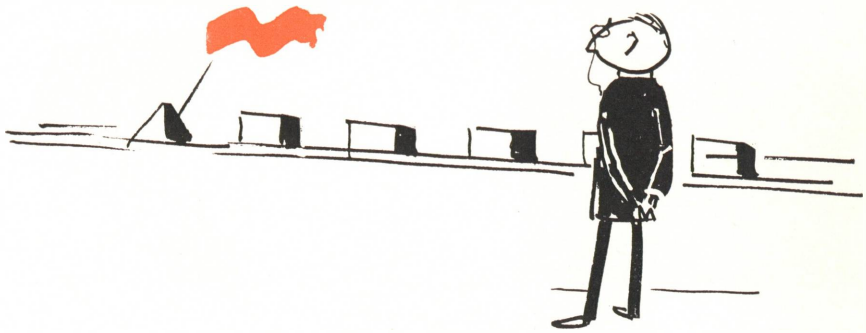
### *Causes of price changes*

Knowledge in itself, without application, utilization, or related action has little practical value. Knowing sales price variances, therefore, is only important if we are in a position to exercise control over these deviations or if this information is desirable for decision making or other purposes relevant to the attainment of business objectives. To appraise the controllability of these variances, the causes underlying such fluctuations must be studied. The nature of particular causal factors will, in many instances, determine to what extent appropriate remedial action is within the jurisdiction and power of the company. Furthermore, a study of causal factors will permit an evaluation of their importance and relevance to various decisions.

An attempt to enumerate a comprehensive list of factors causing sales price deviations would hardly be worth the effort. Even a very general mutually exclusive typology of such causal factors would be extremely difficult to formulate and would have a limited scope of meaningfulness. Each company will, of necessity, have different needs and will have established various responsibility lines for divisions, plants, and other subordinate elements. Utilization of this suggested variance analysis would necessitate its being adapted to the individual prevailing circumstances. With these limitations in mind, the following classifications of sales price variances are presented:

1. Price changes originating with management decisions
2. Price changes originating with salesmen's decisions
3. Price changes originating with market changes

These three major classifications are advanced only as a starting point upon which the reader can expand, incorporating his own experiences and needs, and as a breakdown that allows the following discussion to be presented in a somewhat systematic outline.



Since this system would highlight only the deviations from plan, it would operate in accordance with the principle of management by exception.

[3]This simplified analysis ignores the principles of price-demand elasticities.

**Profit Effects of Price and Cost Changes**

| | Column 1 Assumed Operating Base | Column 2 Labor Cost Increased 5% | Column 3 Material Cost Increased 5% | Column 4 Sales Price Decreased 5% |
|---|---|---|---|---|
| Sales | $100 | $100 | $100 | $ 95 |
| Cost of goods sold: | | | | |
| Direct materials | 40 | 40 | 42 | 40 |
| Direct labor | 20 | 21 | 20 | 20 |
| Overhead | 20 | 20 | 20 | 20 |
| Total | 80 | 81 | 82 | 80 |
| Gross margin | 20 | 19 | 18 | 15 |
| Operating expenses | 15 | 15 | 15 | 15 |
| Profit margin | $ 5 | $ 4 | $ 3 | $ 0 |
| Proportionate decrease in profit margin | | (20%) | (40%) | (100%) |

### *Management decisions*

It is obvious that many price changes initiated by a management may be no more than valid reactions to prevailing market conditions. In such cases, substantiation and explanation of deviations from the planned sales price should not be difficult. However, care must


Many companies will accept additional orders for less than the customary prices during times when portions of their production facilities are idle.

be exercised that this potential "catch-all" explanation is not employed to cover other less justifiable causes, which would permit responsibility for the deviation to be avoided or, at the least, shifted.

Following are three examples which illustrate the potential importance of sales price variance analysis.

It is not uncommon for companies to vary their sales prices to achieve specific short-range objectives. One of the more common reasons for such action is the desire to operate plant facilities as close to practical capacity as is possible. To accomplish this, many companies will accept additional orders for less than the customary or "list prices" during times when portions of their plant are idle. This intentional or planned price variance is identifiable and allocable to certain persons and/or projects, and it should be separated from sales price variances resulting from other causes. If this separation is not accomplished at the time such sales occur, later investigations into the sales price deviation may be laborious and expensive, if not altogether unfeasible. Failure promptly to isolate price variance resulting from special planned sales at reduced prices may lead to the undesirable practice of using occasional sales price reductions justified by temporary idle plant capacity as a general excuse for all sales price variances, regardless of their cause. Most dangerous of all is the risk that such a blanket justification may be accepted by management without further investigation to determine the true causes of continuing sales price variances. Important, and in some instances critical, data necessary for control and decision making are all too often lost in this manner. Furthermore, the specific result of such intentional price reductions becomes intermingled with the results of price variances from other causes, which makes it difficult to measure and interpret the over-all result of such short-range pricing policies.

### *Quantity discounts*

Many companies selling to customers of widely varying size or type utilize a whole family of sales price discounts. Total sales revenues and consequently net profits are to some degree dependent on the distribution of sales among the customer groups receiving various discounts. Material shifts in the distribution of sales among these customer groups could have a significant effect on net margins. Ability to isolate the total price variance resulting from discounts granted to any one customer group should be helpful in optimizing the over-all sales price discount stratagem.

Introductory offers of selected products are another common reason for intentionally reducing prices. In such instances, care must be exercised that these reduced prices are not extended beyond the specifically planned period and/or specified sales territories. Any sales price variance occurring on sales after the planned termination date or from sales territories not specifically authorized would indicate the need for investigation of such practices.

It is desirable to differentiate among sales price variances originating in promotional offers, quantity discounts, and temporary idle capacity. Although all are readily justifiable strategies, authorization for each may come from different responsibility centers. Effective analysis and evaluation of over-all price concession policies may be dependent on the allocation of the total sales price variance among the various responsibility centers and projects.

### *Salesmen*

Some companies extend to their salesmen the prerogative of varying list prices within certain limits. With this prerogative, of course, goes the responsibility to exercise sound judgment in evaluating all circumstances, with the objective of long-run optimal maintenance of the list price structure. The over-all value of a particular salesman to his company depends significantly on his contribution to the firm's profit margin. The amount of profit margin contributed is, of course, influenced by the discretion used in exercising price concession privileges. Some companies have discovered, through rather laborious investigation, that often it is the "weak" salesman who makes the most extensive use of allowable price concessions. Even after replacement of the salesman, these companies have often found a cumulative negative effect, for it is often difficult to enforce regular list prices after prolonged and extensive price concessions.

Measuring the performance of a particular salesman should, to some degree at least, incorporate an ap-

praisal of his ability to maintain actual sales prices as close to list prices as possible. However, this factor is often not measured (or is measured only after substantial delay) because relevant data are not available. For instance, the usual perfunctory comparison of budgeted and actual sales for a particular salesman often fails to reveal to what extent he has used (or abused) his price concession prerogatives. An attempt to measure this factor at sporadic or even periodic intervals all too often means that the necessary information is available only after costly and cumbersome additional analysis involving time delays that seriously impair the potential effectiveness of the control procedure. Timely discovery of such unwarranted price concessions by the salesman is essential.

### *Pinpointing responsibility*

If sales price variances are recorded, these deviations can be promptly and economically associated with particular salesmen who are responsible. Knowledge, on the part of the sales force, that management has access to this information should in itself tend to discourage the use of "soft" pricing policies. In addition, this procedure will help avoid the use of generalized justifications for sales price variances when specific causes can be promptly and economically established. Management can then undertake prompt corrective action in the nature of retraining, indoctrination, transfer, or even dismissal. If the causes of such variances rest in the general conditions of the particular market, a timely change in the company's pricing strategies might help the company maintain its markets and general industry position and avoid the incurrence of ill will.

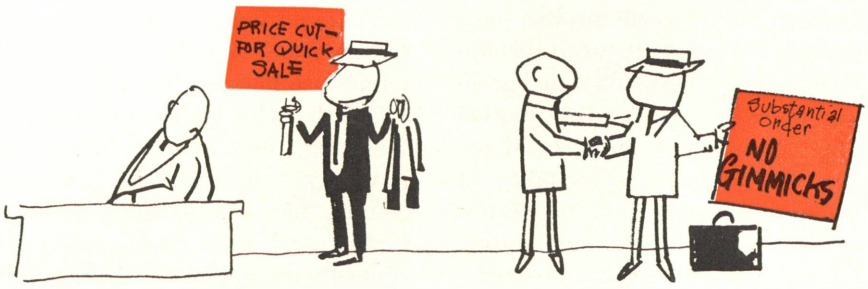
In some instances, sales personnel assume the prerogative of varying prices without first getting proper approval. With a sales price variance system the fact and extent of such practices could quickly be brought to the attention of appropriate persons. Immediate investigation would make it possible to discover important reasons or circumstances which, if not sought at that time, might be later forgotten or confused. Of course, extended periods of unauthorized price concessions are cumulative in their negative effects on profits as well as on market structures and equilibrium. In some instances, price concessions properly approved for specific shipments, if not given sufficient and continuing cognizance, might be used to cover or justify price variances resulting from causes considered by management to be unacceptable.

A sales price variance, if sufficiently detailed, will promptly bring the existence and extent of price changes associated with specific projects and/or locations to the attention of management. Its use will permit the review of circumstances and, where appropriate, the revisions of budgets, alteration of plans, institution of new policies, and timely investigation of new ways by which the company can reach its profit goal.

### *Market conditions*

Effort was made in the previous sections to stress the feasibility and importance of associating sales price variances with specific responsibility centers, purposes, or projects. The causal factors cited as illustrations were largely internal in nature and therefore presumably the primary responsibility of specific individuals.

Some price changes, however, do not originate from internal forces but are the result of general economic conditions, or more particularly, conditions in some sub-area of the economy. A general price decline or specific product line price decline are examples. Many times, for all practical purposes, the cause and extent of sales price variances originating from these causes are not directly controllable by the company. In spite of the uncontrollable aspect of price variances of this type, a strict and separate accounting should be made for them. Validity of the amount and causation of price variances presumably justified by "general or specific economic conditions" should be investigated. Their possible duration should be evaluated. Whereas unfavorable price variances originating with a particular salesman may or may not be material, the possible aggregate effect of any kind of broad and extended price reduction based on general economic conditions must certainly justify any effort at quick identification of the nature and scope of the price trend. A forced price reduction of this latter type,




Extended periods of unauthorized price concessions may have cumulative negative effects on market structure and equilibrium as well as on profits.


To the extent that is possible, sales prices should be subject to the same control efforts as are cost prices.

if material, would most certainly involve changes in all major operating plans and hence place a premium on acquiring relevant information promptly.

### *Evaluation of alternatives*

The relevance of sales price changes to the achievement of specific profit goals was discussed in the previous sections. Emphasis was placed on the identification of causal factors because they primarily determine the actions that are possible and necessary. The question to be considered next is just how these data can be most expediently and economically accumulated so as to permit prompt and accurate reporting, which in turn will permit the proper determination of responsibility and remedial action.

### *Periodic comparisons*

At first, it may appear that a daily or periodic comparison of actual sales prices with list or standard sales prices should provide the data necessary to determine the extent of and to place the responsibility for sales price variances. However, further consideration will disclose some significant disadvantages to this approach. The many different products and widely varying market areas that typify large company operation make the feasibility of such an approach questionable. For which products or in which market areas should price tests be undertaken? A complete or even reasonably comprehensive manual testing on a daily basis would hardly be possible.

Even less frequent periodic testing also has significant disadvantages. A program of periodic testing, besides being vulnerable to various sampling errors, can be criticized because it involves processing large numbers of transactions in which there are no sales price deviations. Ideally, of course, processing and investigation should be limited to those transactions in which deviations have occurred. Another disadvantage of periodic testing is that a characteristic time lag (potentially as long as the time interval between tests) takes place between the actual incurrence of price deviations and their final identification at the time when the next periodic test is performed. The seriousness of this characteristic time lag depends on factors such as the unit sales price deviation, the volume of sales completed, and the duration of the time lag. For many companies the potential seriousness of this particular consequence might be sufficient in itself to preclude periodic testing.

### *Use of budgets*

To avoid some of the above-mentioned disadvantages, many companies use budgets in an attempt to establish sales price differentials. However, there are significant disadvantages involved in this procedure, too. Comparisons between budget and actual sales prices are typically made at periodic intervals. Consequently, sales price deviations could be determined only at the end of a particular budget period. Too often, delayed attempts to isolate specific causal factors find memories vague, explanations conflicting, and a generally unsatisfactory postaudit situation. Furthermore, these comparisons are often made only on an aggregate dollar sales volume. Such comparison is not sufficient to provide even the more basic aspects of the information potentially available from detailed analysis of a sales price variance account. Differences between budgeted and actual sales dollar volumes could be the result of netting a series of favorable and unfavorable sales price and sales volume variances. This aggregate net variance would be a poor basis for designating proper responsibility and taking specific remedial action.

### *Conclusion*

Any variance between actual sales price and the predetermined sales price used in profit planning will affect the extent to which a given profit goal is achieved. Sales price changes, in their ultimate effect on profit margin and to some extent in their controllability, are comparable to cost changes. For this reason, to the extent possible, sales prices should be subject to the same control efforts as are cost prices. Responsibility for sales price variances often can, and therefore should, be established.

An accounting system or system of internal control should be designed to provide for a determination of sales price variances in accordance with responsibility. This system must provide for prompt detection and reporting so as to permit timely isolation of the various causal factors so that proper remedial action can be undertaken as soon as possible. To be most economical, such a system should incorporate the principle of management by exception. These objectives can, we feel, be best accomplished by incorporating in the general ledger a system of recording sales at standard prices so that a comparison with actual sales prices will disclose sales price variances.

*An Orientation Article—*

# EDP EQUIPMENT SELECTION

*There seem to be an infinite number of factors to be weighed in the choice of the best machine for a given application. This article offers some guidelines as to which are most important.*

*by Charles Koenig, Jr., and Kurt W. Bruck*
*S. D. Leidesdorf & Co.*

THE COMPANY which has completed its EDP feasibility study, and has decided that a computer will be a good investment, has completed only the first phase of what will be a long, hard process.

A computer, yes, but which computer? There are many manufacturers, each offering a variety of models. And there appear to be an infinite number of factors to be weighed and judged in the decision. A potentially fatal mistake is to start making major adaptations in the system to fit the capacities of some equipment simply because that particular type of hardware has earned the partisanship—or the awe—of some member of management or of the feasibility study group. They may feel safest in choosing a particular type of equipment, even though that equipment by all the standards of the system they and/or the consultants have designed is not as well adapted for the job as some other maker's. It is in the selection of the computer that the company's consultant can make his largest contribution, because he should approach the problem with a completely open mind.

At least at the outset it should be assumed that all equipment offered by the well-known electronics manufacturers is reliable. There are few secrets between manufacturers; the constant traffic in engineers among the companies insures that. So, any tendency to choose one machine complex over another simply because its manufacturer is favored, for whatever reason, is to be resisted. We belabor this point because only the equipment that most closely fits the requirements of the system that has been worked out is the equipment that should be selected, except in very special cases.

### *Requirements*

To prepare for such a selection, the first thing the consultant and the study team must do, the first step in equipment selection, is to spell out in detail just what the equipment is expected to do under the proposed new system, the quantity of data it will have to handle, and the interval of time permitted for processing. These are the basics, and the more detailed the information is the more finely tailored the installation can be to the exact needs of the purchaser. Much of this information may not have been gathered during the EDP feasibility study. However, the feasibility study should have resulted in at least the following:

1. What are management's needs and objectives?
   a. Reduction in costs?
   b. Improved service to the company and customer?
   c. Improved management of the business, etc.?
2. The formation of a hard core data processing staff or study team on a full-time basis, guided and supplemented by the experience of the company's consultant
3. Detailed write-ups of present and proposed systems, complete with flow charts and input and output format requirements
4. Document counts of all input data, both at normal and peak periods, noting where the input


Precise specifications should be prepared and submitted to all makers of equipment that is likely to be suitable. This is an aid both to the manufacturer, in preparing his proposal, and to the would-be buyer.

originates and the approximate timing for the receipt of the input data

5. The number of personnel currently needed to process the operations to be computerized and an estimate of the personnel savings to accrue under a computer system

6. A listing of all major files currently being maintained and the detailed content of these files

7. Exceptions to routine processing

With the above data as a background, the consultant and the study team will have already conducted meetings with all concerned parties throughout the company, considered revising existing operating procedures, and notified management in writing of the results of the feasibility study. Management, on the basis of this written report, has made the decision to proceed with the computer study. We are therefore ready to proceed to the next step. Based on these efforts, the consultant and the study team, in effect, design their ideal machine specifications—then investigate which data processing complexes most nearly match it.

A review of manufacturers' literature readily available to the consultant can quickly and accurately identify those whose equipment seems most nearly compatible with the systems requirements. There is obviously no point in asking a manufacturer specializing in scientific processors with high internal operating speeds, but low input and output speeds, for proposals on a system which calls for the processing of an enormous amount of data through comparatively simple processing steps.

### *Proposal request*

There are two ways to request proposals: (1) Disregard the feasibility study and request that the manufacturers start from scratch. They will send in systems men who will study your present systems and devise new systems tailored to work on that manufacturer's equipment. They will time out the operations and, infrequently, will estimate the potential cost savings to accrue from the installation of their computer. (2) Based upon a feasibility study conducted by the consultant with the aid of the company's personnel, submit to the manufacturers your flow charts outlining the specific areas and systems which the company wishes to computerize, showing the necessary computer runs, the inputs and outputs required, and giving a brief explanation of the processing involved.

In practice we have found the latter approach to be the only logical one. The former approach results in a lengthy systems review conducted on your premises by each computer manufacturer's systems people, which is very time-consuming on the part of key personnel and very often leads to illogical systems approaches because of the manufacturer's inability to learn the company's systems in the necessary detail in the short time allotted. Most serious of all, it results in different approaches by each manufacturer, usually due to specific idiosyncracies of his equipment, that are virtually impossible to evaluate on a relative basis when the machine proposals are finally received. Thus, we think that precise specifications should be prepared and submitted to representatives of manufacturers of likely suitable equip-

ment. Therefore, in effect, the process of preparing the specifications is an aid to the manufacturers in that it puts in writing precisely what it is that the company wants the equipment to do and the approximate price range or rental fee the company is prepared to pay for getting the job done.

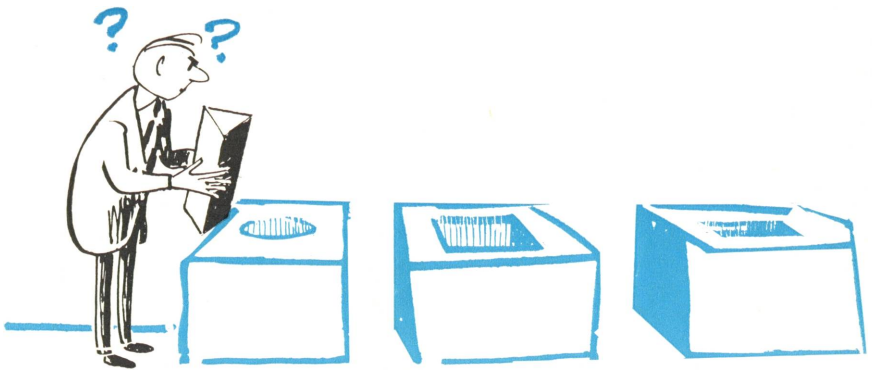
The chosen manufacturers, when they receive the specifications, then go to work themselves detailing just how their equipment could handle the jobs the company wants done. In effect they are complementing the systems design already completed by the consultant and the study team, showing precisely how their equipment could be used within the system, what kind of input would be required, and what kind of output it would produce. The time taken for each operation for a given quantity of data should be part of the proposal.

### *Analysis of proposals*

Upon receipt of the machine proposals, the actual evaluation will begin. A detailed analysis of each manufacturer's proposal must be made by the consultant, preferably in conjunction with the original study group. This evaluation of necessity entails much work and time and should result in the following benchmark answers for each proposal:

1. Configuration proposed
   a. Card-oriented
   b. Tape-oriented
   c. Random access storage
   d. Main-frame storage
   e. Input and output devices
   f. Special devices
2. Cost of intended installation
   a. Machinery cost
   b. Start-up cost
3. Manufacturer's policy of rental, purchase, and overtime use agreement
4. Timing of individual operations and total estimate of monthly usage and monthly available hours
5. Estimates of intended cost savings detailed by department

By using the above analysis, it should be possible to select those manufacturers who have submitted a "ball park" proposal and thus eliminate those manufacturers' proposals from consideration which do not fall within the range either in costs or timing factors. For a variety of reasons some of the proposals may not adhere to the outline of the system requested. Due to machine limitations or a desire to advance a certain machine feature, the manufacturer may have materially altered the proposed system. This must be resisted at all costs in order that all proposals can be evaluated on an equitable basis.



Computers designed on the modular principle can be expanded without replacement of all equipment or reprograming as the system grows to meet new needs.

After this winnowing-out process is completed, there will probably be more than one manufacturer who has offered equipment configurations that look as though they will do the job that has been outlined. Concentrating on the remaining proposals, staff meetings are held with the consultant, the study team, and department heads to analyze the approaches used by the remaining manufacturers. At this time it might be necessary to call in representatives of the machine companies to elaborate on their proposals.

### *Selection criteria*

After proper evaluation of each proposal, the consultant and the study team must make a decision. In the present state of the computer market the decision is no longer solely made on price as it was several years ago. After determining that each proposal is economically justifiable, there are other important factors, such as the following, that in a large measure influence the decision:

### *Modularity*

1. Modularity of the proposed configuration. Can the computer be expanded to meet future needs of the company without the expense of reprograming? It is possible, without a change of basic configu-

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***Previously we were concerned primarily with the speeds with which individual processing elements could operate. Now we are more concerned with "throughput," the net time required by the equipment to process all phases of a job.***

zation of many of the already installed systems by adding main frame storage, increasing magnetic tape speeds, increasing the speeds of the input and output devices, and even increasing the speed of the print units. In addition, when systems needs have grown beyond the capacity of an already installed configuration, it is possible, with some manufacturers' equipment, to install the next size range of equipment without having to start from scratch and build a system and rewrite programs. This is so because the programing language of the two configurations is effectively compatible. Conversely, some manufacturers offer equipment that is not compatible and/or expandable and may consequently require lengthy and costly systems and programing efforts each time computer capacities must be expanded. If possible, the latter condition should be avoided and the determination of the modularity or expandability of the equipment examined in view of future needs before placing an order.

### *Simultaneity*

2. The ability of the computer to handle simultaneous operations. Many of the computers on the market can simultaneously handle two or more operations. In today's technology we are more and more hearing the term "throughput." This is the net time required by the equipment to process all phases of a job. Previously we were concerned primarily with machine speeds, i.e., microseconds of access time, card reading and punching speeds, character rate per second tape speeds, etc. Each processing element was timed separately and all elements added together to arrive at the total processing time. Today with overlap possibilities and multiple channel circuitry we are more concerned with the way complete jobs can be processed simultaneously and the length of time taken for processing all elements per job, instead of the sum of individually timed job segments. The fact still remains that it is virtually impossible, without first programming, to time out jobs with a high degree of accuracy. But equipment that offers processing overlap will obviously process jobs faster and thus require significantly less throughput time, providing the data and logic mix allow us to make use of such capabilities. In addition, demand interrupt features with executive routines available on some computers make it possible to improve throughput time by "multiprocessing" two or more jobs simultaneously, where the relatively slow input-output requirements of several jobs can easily be digested in the main frame of the computer, which might otherwise stand idle awaiting completion of input-output functions of a single job.

### *Overtime rental*

3. The manufacturers' policy on overtime rental. In the case of more than a one-shift operation, the policy of overtime rental can be a significant factor in the cost of the computer. Some manufacturers offer a base usage of 176 hours per month, some 200 hours per month, and others even more. Some have a very strict accounting of all overtime hours used while others have a more liberal policy toward excess usage beyond a one-shift basis. The rates on a second-shift rental can run as high as 40 per cent of the base rental for the excess time used, but significant differences might be found between manufacturers.

When overtime costs are involved, a cost analysis should be prepared detailing rental costs (including overtime costs) vs. purchase costs (including maintenance and amortization). The analysis should determine if the purchase of the equipment is justified and, if so, a recommendation for purchase should be made to management, after having given full consideration to obsolescence.

### *Delivery dates*

4. Delivery dates on equipment can be an important factor in placing an order. Although it might

appear that the ability to receive equipment on a short-term basis would be advantageous, this is not always the case. It will be to no avail to take early delivery of equipment if the company is not ready for it. Usually it has been estimated that a minimum of one year's effort (multiple man-years) is necessary for systems work and programing before acceptance of the equipment. However, it can also be a disadvantage to be ready to utilize the equipment and have to wait many more months for delivery, installation, and operation.

Although often overlooked, an important function of the consultant is to determine the proper delivery date of the equipment. Too early delivery can result in significant additional cost to the client and possibly chaotic conditions because of crash programing in order to minimize the added cost. Too late delivery can result in the loss of efficiency and morale in the systems and programing group and unnecessary delay in achieving the ultimate goals which were the motivating forces in deciding to make a computer installation in the first place.

### *Software*

The "software" available with every equipment configuration should be checked very carefully. All manufacturers, as a result of their experience in the field, have developed libraries of complete processing routines or sub-routines which they will make available to all their customers without charge. If the system that has been developed contains elements covered in these libraries, such as sorts, etc., many of these packaged programs can be used or adapted very easily with a consequent significant saving in programing time and expenses. In addition to softwear packages there are varying degrees of programing complexities between manufacturers. It is estimated that the cost of programing is equivalent to one year's rental of the equipment, and in the case of a complex programing system, this cost might be substantially more.

### *Program language*

Since the costs to program the computer are never trivial and the technological advances in the computer industry occur at such a rapid pace, it might be assumed that some time in the future the computer under consideration will be replaced by a new generation specie. A costly reprograming task may be expected at that time unless (1) the second machine has compatibility with the first, either in engineering design or through packaged conversion programs, or (2) the language for the first computer was COBOL (Common Business Oriented Language) and the general systems approach has not changed in the interim. Thus it becomes a calculated risk to choose between COBOL, a somewhat more difficult form of programing but which offers the promise of reuse in future years, or the manufacturer's own, and generally more efficient, mnemonic coding system which offers less chance of salvage in the future, Generally, we feel, the choice should hinge on the life expectancy of the computer under consideration. If it appears that the first computer will satisfy the company's needs for at least four years of operation, then we would favor ignoring COBOL availability or use, since after such a period the chances of general systems retention become very small.

If the client is a division or subsidiary of a larger company which already has a computer and "cross talk" between computers is desirable, it goes without saying that a check should be made to insure that the existing computer's input and output formats are compatible with those of the proposed addition.

As stated previously, it is extremely difficult to estimate machine-usage time prior to writing detailed programs. However, logical estimates must be made to

Manufacturers' policies on overtime rentals can have a significant effect on the cost of running a computer.

guard against buying or renting a computer with greater capacity than is required under present needs. However if the company is expanding so rapidly that obviously the data processing load will be substantially heavier by the time the computer is installed, there would be justification for the installation of a larger computer. But, by the same token, a computer based on modular units should be considered if future expansion is probable. A minimum of upheaval and expense will be encountered under such circumstances. Thus, many manufacturers offer a whole range of configurations composed of individual units—input units, central processors, memory units, output units, which can be assembled in configurations of varying power, speed, and ability. The one error to avoid is being trapped in a system which has been outgrown and cannot be expanded.

***Although the probability of future expansion might justify acquiring a computer with greater capacity than is required for present needs, it is probably wiser to consider a computer based on modular units. The one error to avoid is being trapped in a system which has been outgrown and cannot be expanded.***

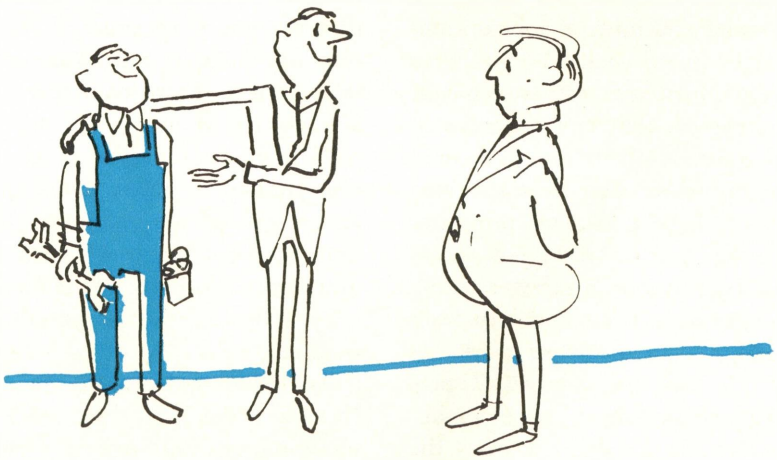
### *Servicing*

Even when all of the above factors have been taken into account, the list is not exhausted. Machines break down—and there are endless wholly unanticipated problems when they are first installed. There is usually very little difficulty in getting service from the manufacturing company—any manufacturing company—in a large city, but suppose the installation is in a smaller community some distance from a large metropolitan center. The number of trained and available technical personnel who could be called on in an emergency could be entirely different for two manufacturers whose equipment otherwise is equally desirable. Trained personnel readily available to take care of mechanical troubles or breakdowns are a very important factor in the success of an installation.

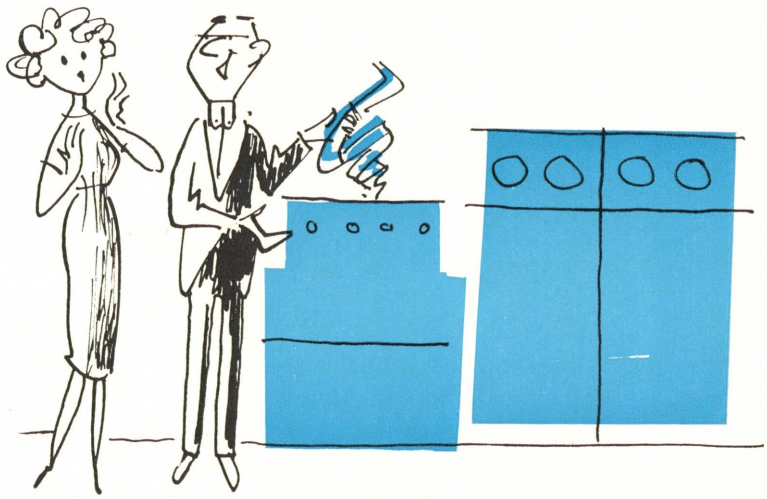
### *Personnel*

Equally important is the number of technical people the manufacturer will supply and the length of time for which he will supply them when the installation is first getting under way.

These machine company people are distinct from programers and coders, who should always be employees on the client's staff. As a general rule, we think a company going into electronic data processing for the first time is best advised to make a strenuous effort to build its staff from within the company. If people already on the staff possess the necessary skills and aptitudes to become programers, there are many advantages in sending them to a programing school maintained by the manufacturer. The company has better protection—



Outside the largest cities, the quantity and quality of service available from the manufacturer is an important consideration in the selection of equipment.



Generally, a company going into EDP for the first time should make every effort to recruit personnel internally for technical training by the manufacturer.

such personnel have already developed ties and a certain loyalty to the company. Moreover, they are more familiar with its peculiar problems and will have less difficulty in blocking out the detailed machine steps necessary to convert the flow charts of the systems designer into the block diagrams of the programer.

What are the necessary skills and aptitudes to become a programer? How is one to tell whether the necessary abilities are represented in the staff?

Here the manufacturer can be of help, once a definite machine complex has been decided upon. He will give aptitude tests to those of the customer's employees who seem likely prospects, and aid in the final selection. Then the selected employees will be trained in programing techniques at a school maintained by the manufacturer.

One final caution: If programers are to be selected from within the company (or, for that matter, if outside programers are to be hired) they should be sent to school well in advance of machine installation. Programing is a long, involved process and takes a great deal of time. The program for any given data processing job should have a long lead time, or the company is apt to find itself with an expensive machine installation for which it has no programs. This may seem the most obvious of truisms, but it is a point which many companies have overlooked to their grief and expense. As computer prices continue to come down, programing expenses are likely to become proportionately even higher. The systems staff is as important as the programing staff. As mentioned previously the nucleus of the systems staff is usually the original study team. This team should be augmented as necessary, by staff members selected from within the company—preferably with experience in departments whose work will be absorbed by the new computer.

The care and training of programers may seem quite divorced from equipment selection. In one way it is, but chronologically it is so closely allied that selection of future programers and the beginning of their training should occur almost as soon as final equipment choice has been made.

Since this article is one of a series (the first of which was "The EDP Feasibility Study," MANAGEMENT SERVICES, July-August, p. 48) and the next installment will deal with the installation of EDP facilities, suggestions about selection and preparation of the study team and the programers seemed most appropriate in this article.

In summary then, it can be stated that the equipment selection should be preceded by a computer feasibility study and the ideal systems design. The final selection of the most suitable equipment will probably require some systems modification. If these steps are not taken in the stated order, the chances of just getting a better mouse trap for the same old system are very high. It must be remembered that new technologies offer entirely different solutions to data processing and management needs. It is the challenge of the consultant and the systems team to discover better systems concepts first, then institute them with the best tools available.

*One of the most useful approaches to cost control available to industry was originally developed for purchasing, but its value is not limited to that department. This article reviews the principles and applications of*

# VALUE ANALYSIS

*by Edward Blake*
*Upsala College*

VALUE analysis, the evaluation of a product in terms of both cost and performance, has become an established technique in purchasing. Few executives in other functions are familiar with it. This is a pity, for the basic concept—if broadened to include services as well—has many applications outside purchasing.

Value analysis can be used to analyze and evaluate the products a company manufactures as well as those it purchases. It can be used to measure the value of the "products" of such company functions as accounting. In each case value analysis is more than just another cost-cutting approach. It is a method of obtaining maximum performance at minimum cost. Because value analysis is basically an attempt at quantification—of performance as well as cost factors—it is a natural tool for the accountant or financial executive. He can play an important role in its application to the analysis of purchased products, manufactured products, and the services provided by company departments.

### *Purchasing*

In many companies the purchasing department has added value analysis to its functions of quality, quantity, timing, cost, service, and source selection. As practiced in those companies, value analysis has two dimensions:

*Price analysis* is an investigation of a supplier's direct and indirect costs of producing a raw material, component, or supply item so that prices related closely to his actual cost of production can be negotiated. Such analysis may lead to changes in specifications, the detailed descriptions of the material's characteristics, and thereby result in reduced costs of production. The primary objective, however, is to evaluate existing costs.

*Product analysis* is the analysis of the performance of a purchased material so as to define adequate quality at the lowest ultimate cost. It may result in changes in specifications of raw materials or production processes, in simplification of the design of assembled components, or in changing requirements so that standard items of supply may be used. Such analysis may lead to negotiations that reduce prices un-

der existing specifications. Its primary purpose, however, is to challenge specifications so as to relate designs to the production resources of suppliers.

*Value analysis* combines the objectives of price and product analysis. It is the investigation of the performance of a material, component, or service in terms of its unit price so as to develop the most effective specifications at the lowest ultimate cost.

One company describes the process as "the engineering of unnecessary cost factors out of the purchased item." Another has a more elaborate definition that goes something like this: "Value analysis is the study of the relationship of design, function, and cost of any product, material, or service with the object of reducing its cost through modification of designs or material specifications; manufacturing by a more efficient process; change in source of supply—external or internal (make or buy); or possible eliminations or incorporations into a related item."

When all the many and varied factors that must be included in a supplier's price quotation are analyzed, the hard core of cost is eventually found in the manufacturer's cost of production. This is the irreducible minimum. There may be some leeway in such factors as overhead charges, the cost of sales and distribution, quantity differentials and quantity manufacturing economies, profit margins, and competitive pricing policies, and these have always been considered legitimate areas for purchase inquiry and negotiation. The cost of production, however, has been properly accepted as untouchable. It is assumed that the buyer will select a supplier whose production methods are efficient and whose costs are competitive. Any attempt to purchase below the cost of production apart from the ethical and legal considerations involved, merely tends to destroy the source of supply.

The user of value analysis recognizes that there is an alternate possibility. The supplier's basic costs of manufacturing are largely determined by the design, materials, and methods specified by the buyer for production of the purchased items. It is possible that the item itself involves an unnecessarily high cost for its intended purpose. If so, the buyer and his associates can attack that hard core of basic production costs, trying to eliminate or modify any unnecessary features of design and resulting manufacturing operations and eventually arriving at a specification or part which really is the most economical product that will satisfy the end-use requirements.

Thus, the value analysis approach has much to commend it in terms of purchaser-supplier relationships. It does not involve attempting to "squeeze" the supplier to reduce his normal margins of profit. It produces one of those happy situations in which everybody wins.

Value analysis does not put any "squeeze" on suppliers. It is a happy situation in which everybody wins.

### *Check list*

This approach to the problem of cost is well summarized in the check list of ten "Tests for Values" compiled and used in the purchasing department of the General Electric Company. This code is widely circulated and used throughout the various divisions and departments of the company. Every part, material, operation, and service must pass these tests:

1. Does its use contribute value?
2. Is its cost proportionate to its usefulness?
3. Does it need all the features it possesses?
4. Is there anything better for the intended use?

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The purchasing department is a natural focal point for cost attention since every specification is reviewed there.

5. Can a usable part be made by a lower-cost method?

6. Can a standard product be found that will be usable?

7. Is it made on proper tooling, considering quantities used?

8. Do material, reasonable labor, overhead, and profit total its cost?

9. Will another dependable supplier provide it for less?

10. Is anyone buying it for less?

Each of these points might be amplified as follows:

1. Analysis may disclose that a certain part of a total component is no longer necessary and adds no value to the item.

2. An item's function may be so simple as to be obviously disproportionate to its usefulness. Substitution of cheaper materials may be the answer.

3. Analysis may reveal that a part does not need all of its built-in features to do an acceptable job.

4. Again, a substitute material may work as well or better and at a lower cost.

5. A one-piece casting method may be substituted for a two-part riveting method.

6. Standard-design studs, bolts, or materials may easily be used in many cases instead of custom-made items.

7. Different quantities can require different tooling, sometimes with a cost advantage.

8. If suppliers are called in to review specifications and tolerances with the buyer, changes that will cut costs can almost always be discovered.

9. Fuller exploration of the supplier market may show that other, more efficient suppliers can do the job for less.

10. Research may show that one division of the company is buying a certain part at a price of x plus per thousand. Another division may be buying a similar part, suitable for the first division, at a price of x minus per thousand.

### *Whose responsibility?*

Only the last three of these examples are of a strictly purchasing nature; the first seven are more closely concerned with engineering design and manufacturing methods. The question naturally arises: Why is value analysis considered primarily a purchasing function? There are several important reasons why it is logical for purchasing to have initiated and promoted the activity and why it is customarily centered in that department:

1. Purchasing is responsible for a large proportion of costs in many companies. Often it spends from 50 per cent to 60 per cent or more of the company's dollars for materials, component parts, and services.

2. Purchasing is a natural focal point for cost attention. It is a department in which each specification and requirement, from whatever source within the company, must pass in review.

3. Purchasing, perhaps more than any other department, must be cost-conscious with respect to the materials, parts, and services that go into the company's end product. This is an integral part of the buying responsibility.

4. Regardless of how much cost reduction activity is carried on in other departments, it is still the responsibility of the buyer to seek maximum value when a product request reaches the point of purchase.

5. The purchasing staff has become "cost-wise" through experience in price analysis and comparisons of alternative materials. Furthermore, buyers are exposed daily to new products and to vendors' sales presentations.

6. Purchasing is objective about costs. Its staff is typically capable of greater objectivity than anyone can have whose first concern is the use or performance of a product.

Actually, of course, value analysis is everybody's business, and it is most effective when ideas come from every part of the company. Value analysis by purchasing does not encroach upon the functions or prerogatives of other departments. The cost reduction possibilities disclosed are initially presented as recommendations to those who must ultimately define the need. When-

ever changes in materials, design, or processes are involved, approval by engineering or manufacturing departments is essential before a specification is changed. If a suggestion has merit, the actual changes are often worked out in these departments.

The initiative need not always come from the purchasing department. The opportunities open to the engineering department to cut costs by redesign are obvious. The financial executive's role in price and cost analysis is equally crucial. He might, for example, assist the purchasing agent with a financial analysis of a vendor's operations aimed at studying the allocation of costs to a particular product line so as to eliminate unwarranted overhead and other charges. Or he might work up cost figures on selected items manufactured within the company so that the purchasing agent could compare them with the prices paid to outside suppliers for similar products or parts. The alert financial executive need not wait for the purchasing agent to request such information. If the relations between the two departments are sufficiently cordial, the initiative may well come from the financial group.

### *Internal analysis*

Similarly, in controlling the costs of internal products and operations, top management needs the cooperation of all departments—purchasing, sales, production, and finance. Through accounting statements and statistical controls, top executives can usually pinpoint the areas where costs are rising. But they cannot, by themselves, do much toward lowering the cost of each unit of product. Every department must make its contribution toward this end.

Value analysis is just as sound a concept in internal cost control as it is in purchasing. Too often management leaps into the cost reduction battle to reduce excessive drains on pencils and paper clips and to perform other useful but minor economies. If worst comes to worst, studies may be conducted to determine just how much the clerical or production personnel can be cut back by reassignment and increased workloads. Behind these activities lies this assumption: "We will keep our same old antiquated procedures, accounting practices, and manufacturing methods; we will just do it with fewer people." This is not the answer.

Nor is it the answer to reducing the cost of products. A routine cost session often finds management—after looking at a product and asking, "What is it? How is it made? "What does it cost?"—wondering, "How in the world do we sell it as cheaply as we do?" What is done in this case is to develop—quite inadvertently—a permanent place for the product, the process by which it is manufactured, or even the material from which it is made. The wrong questions have been asked. The real question is not "What is the product worth?" but rather, "What is its function worth?"

Every product, every activity, every service should be examined in the light of its performance and its utility as well as its cost. This is the dividing line between normal cost reduction procedures and value analysis.

### *Broad approach*

Application of value analysis to over-all company operations requires a broad approach. Top management must decide which products, staff activities, or cost areas breed clutter rather than bring opportunity and results. Then it must decide what to do about them. Which should be abandoned altogether? Which should be maintained at a minimum effort? Which could be changed into major opportunities, and what would it cost to make such a change?

To make these decisions requires information, and the financial executive is the logical one to supply it. He needs to be able to identify the opportunities and true costs of products, the potential contribution of different staff activities, and the

***In routine cost sessions really basic questions are seldom raised. Management should not ask, "What is the product worth?" but rather "What is its function worth?" Every product, activity, and service should be examined in the light of its performance and utility as well as its cost.***

economically significant cost centers. He should be able to supply information on how resources are now allocated, how they should be allocated in the future to support activities of greatest opportunity, and what steps are necessary to get from what is to what ought to be.

***Products***

The first step is to take an unsentimental look at the product line. All the standard facts should be gathered about each product: its volume, market standing, market outlook, and so on. There is, in addition, one key question: What does the product contribute? What is shown by a comparison of its revenue with its true costs?

In this analysis, revenue should be defined as total sales dollars less costs of purchased materials and supplies. The costs of a product should be estimated as the proportion of the total costs of the business that corresponds to the ratio between the number of transactions (orders, production runs, service calls, and the like) needed to obtain the product's revenue and the total number of similar transactions in the business—again less materials and parts costs. Since this definition is rather cumbersome, an example follows:

Company X has annual revenues of $68 million, after deducting costs of materials and parts purchased. Total costs of the business, materials and parts again excepted, are $56 million.

Product A shows revenues of $12 million a year. It requires, however, 24 per cent of the total number of transactions, measured in this case by invoice. Its costs, measured in the manner just outlined, are therefore calculated to be $13.5 million a year. This finding that Product A makes a negative contribution to profit is in sharp contrast to the "official" profit margin of nearly 12 per cent shown by the accounting figures. This is fairly typical for "yesterday's product," which has either lost its principal customers or can be held in the market only by efforts that are uneconomic.

Product B, by contrast, despite an "unsatisfactory" profit margin of only 3 per cent, shows a net revenue contribution of almost $4 million, the largest single contribution to profit. It goes in sizable orders to a small number of substantial customers.

While the product breakdown is usually the most important and most revealing analysis, customers, markets, distribution channels, and end uses all can be analyzed in the same way to determine their present and anticipated contributions.

***The value analysis technique can be used to analyze the contribution of staff services as well as products. Management should seek to identify the areas in which outstanding or unusually poor performance would have a major impact on the company and concentrate on improving the results attained there.***

***Staff services***

The same technique can be applied to analyze the contribution of staff services. Here, however, the questions to be asked call for managerial judgment rather than for economic data. Possible queries include the following:

In what areas would excellence really have an extraordinary impact on the economic results of the business, to the point where it might transform the economic performance of the entire company?

In what areas would poor performance threaten to damage economic performance significantly?

In what areas would it make little difference whether the performance were excellent or poor?

What results have been attained by the work done in the area? How do these compare with the results promised or expected?

What results can realistically be expected for the future and on what sort of time schedule?

***Cost centers***

The object in identifying significant cost centers is to isolate those areas of the business where a concentration of cost control efforts will pay off. One company is experimenting with a definition of cost as what the customer spends on the product. In other words, it is looking at the entire economic process as one cost stream, ignoring the accountant's restriction that only

costs incurred within the legal entity of the business should be considered.

As a result, this company has concluded that in manufacturing, where most businesses concentrate their cost control efforts, there is not much to be gained except by a real breakthrough, such as a radically different process. The potentially most productive cost centers either lie outside the business, especially in distribution, and thus require very different treatment from the usual routine of cost reduction, or they are areas that management rarely even sees, such as the cost of money.

### *Allocation*

The next practical step is to analyze how resources are now being allocated to product lines, to staff support activities, and to cost centers. The analysis must, of course, be qualitative as well as quantitative. Numbers by themselves do not give the answers to questions like these:

Are advertising and promotion dollars going to the right products?

Are capital equipment allocations in accord with realistic expectations for future demands on the company?

Is the company's allocation schedule supporting the best people and their activities?

Are these good people deployed full time on important jobs or are they spread over so many assignments that they cannot do any one job properly?

Answers to questions of this sort are often unpleasant, and the remedies they cry out for are unpleasant to contemplate. Moving from the allocation stage to the stage of decision may take courage.

Furthermore, the ultimate decisions on these major strategic and tactical questions are the responsibility of top management. But there are many decisions that can be made by department heads and functional executives. Each department head can apply value analysis to the operations under his own control. The financial executive might well be the one to provide the model for other department heads to follow.

### *In accounting*

To uncover opportunities for improvement in accounting functions, systems, and procedures, the financial executive might adapt the G. E. check list as follows:

1. Does its use contribute value? Of what real value are some of the data, information, and reports that are accumulated and made up in the accounting department?

2. Is its cost proportionate to its usefulness? How much does it cost to gather and maintain some accounting records in relation to their actual use in the company?

3. Does it need all the features it possesses? Are all parts of the accounting procedures essential to the end product delivered to operating executives?

4. Is there anything better for the intended use? Could some other report in some other form do the same or a better job? Perhaps a report prepared and filed in the production or sales department could be substituted.

5. Can a usable part be made by a lower-cost method? Can reports be produced at less cost—through mechanical, electro-mechanical, or electronic equipment?

6. Can a standard product be found which will be usable? Can reports, records, and systems of gathering and reporting information be more standardized.

7. Is it made on proper tooling, considering quantities used? Are all accounting reports prepared mechanically or electronically when hand calculation would do as well for some of them? Or, conversely, are many man-hours wasted in tedious pencil-and-paper work when the volume and complexity of the work cry out for mechanization?

8. Do material, reasonable labor, overhead, and profit total its cost? Do forms, people, and overhead constitute all the costs of accounting operation, or are there hidden costs? What can the department do to contribute to over-all profitability?

9. Will another dependable supplier provide it for less? Can some routine data processing work be farmed out to an organization specializing in that field?

10. Is anyone buying it for less? Is the accounting department really efficient?

### *Under new management*

The following actual example illustrates the basic approach:

The manager of a large organization kept observing signs in store windows and offices reading, "Open Under New Management." He got to thinking about what would happen if he stepped out of the picture and a new person took his place. He asked himself what the new manager would do. Aware that nothing succeeds like a successor, he decided to imagine himself his own successor and put up a sign, "Under New Management," to remind himself of the idea.


He wondered where the new manager would start. The desk piled high with papers seemed an obvious place. As he picked up each document, he questioned what his successor would do under the circumstances and proceeded to take action without delay. After he had cleared the top of the desk, he took the file drawers one at a time and was amazed at the obsolete material that could be removed. So much additional file space was made available that what was left there looked almost lost. From then on he con-

tinued to question all current work and new reports, trying to handle them just as his successor might. Soon he found himself taking a fresh look at every aspect of his job, discarding inefficient methods and procedures that had become habits over the years.

A financial executive adopting this "Under New Management" plan might find himself not only re-evaluating his normal work but taking steps to do many things he had been putting off. He might put down on paper or in manual form the primary objectives of his department. He might redefine the functions and authority of his subordinates, indicating clearly the organizational lines and the relations with other departments. He might outline each step in the accounting function in detail, including the establishment of records, the need for them, their preparation and processing, and the like. By use of this technique he might even actually make way for his successor, and himself become a successor in a higher echelon.

### *For everyone*

Thus, it is clear that the basic techniques of value analysis are applicable to every aspect of company operations, from the broadest strategy to the narrowest function, and to every company, large, medium-sized, or small. Some people say, "Value analysis may be fine for the big companies that have high volume or for the manufacturing companies that have production parts which can be redesigned, but I am in a different kind of business or profession. It simply does not apply to me."

Such people have missed the point of value analysis. They have never tried to analyze products, services, or processes that have nothing to do with manufacturing, asking questions like these:

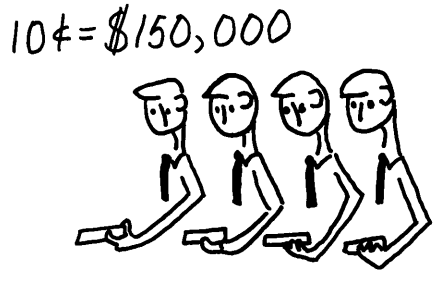
1. Could we use tourist accommodations instead of first class when traveling by air?

2. Would compact cars do just as well as standard models when transportation is required at destination?

3. Are the costs of telephone, utility, and transportation services proportionate to value received?

4. Do record keeping and internal accounting procedures meet the test of value? What about the volume of overtime?

Anyone can use value analysis. It can be applied to every function a person encounters in his work each day, the function of parts or materials he buys, the function of processes or methods he uses, the function of printed forms and reports. It is the continuous application of the philosophy that everything everyone does can probably be done a little better, a little less expensively, a little more efficiently. It works for everyone—the sweeper and the stenographer as well as the purchasing agent, engineer, manufacturing man, accountant, or president.




In modern industry no unit saving is too small to merit respectful attention. Small unit savings multiplied in the total production program quickly mount to impressive dollar figures. In automobile manufacture, for example, changing one small component from forging to an equally serviceable screw machine product may save 4/10 of a cent per unit — an insignificant amount. But 16 of these parts are used on every car. The annual savings are $64,000.

Typical savings effected through value analysis actually run to many times this modest example. To anyone unfamiliar with the workings of the technique, the tangible savings reported by its users may seem fantastic, whether considered as a percentage of previous costs or in relation to the cost of the activity itself. Almost without exception, companies that maintain accurate records of savings find that every dollar spent in value analysis work is returned many times over. These savings are repeated and multiplied in succeeding years' purchases and production.

Even in companies where the value analysis programs have been carried on for ten years or longer, there is no indication that the procedure is even approaching the point of diminishing returns. Instead, the habits of mind engendered throughout an organization give added momentum to the program.

### *Cost inflexibility*

Over the years the trend in American industry has favored the building of additional costs into the basic cost structure in the form of higher labor rates, more expensive raw materials, and higher taxes and other costs of doing business. This trend has been offset to some extent through mass production, greater mechanization, and higher productivity, but the shrinking purchasing power of the dollar is evidence that it has not been offset fully.

Each increment in basic cost of manufacturing reduces cost flexibility and tends to perpetuate prices on a higher plane. Under these circumstances anything that can be taken out of basic cost as a direct item-by-item saving is significant. Such savings permanently eliminate cost factors and conserve productive effort. They are repetitive, multiplied many times over in quantity requirements.

In every company, in every department, in every activity there is ever-present possibility for improvement. As Henry Ford once said, "Businesses that grow by improvement do not die. But when a business stops making creative improvements, when it believes it has reached perfection and needs to do nothing but produce, it is done for."

*Every business—most of all the job shop—needs to be able to predict costs accurately. The method used should conform to the over-all operating plan. This article emphasizes the importance of—*

# BUDGETING—FIRST STEP IN COST ESTIMATING

*by Allen Weiss*
*Anchin, Block & Anchin*

SETTING prices to earn a profit in a competitive environment requires a rather precise knowledge of costs, combined with an ability to control them. Whether a company is bidding for specific contracts or for more general markets, its prices must be low enough to attract customers yet high enough to provide a margin of profit after recovering all costs. There is, therefore, a continuing need for accurate cost prediction (estimating) in all businesses.

For the job order manufacturer, turning out a variety of products to customer specifications, estimating in advance of production is all important. While the primary purpose of this article is to discuss the relationship between budgeting and estimating for these industries, it should be remembered that makers of proprietary items are also continually estimating the costs of new products. These new products may be entirely new to the line, or they may be modifications of old ones.

In any case, the need for estimating cannot be filled by piecemeal attempts to improvise whenever a new product or a new contract is under consideration. There must be an estimating method that conforms to the over-all operating scheme. There must be a plan, or budget, for the business as a whole, and cost estimates must be based on that plan.

Once a budget has been adopted, its usefulness is not restricted to estimating. It becomes the principal tool of managerial control, permitting measurements to be taken along the way to ascertain that the plan is in fact carried out. Thus, the budget provides both the data for estimating costs and the means for controlling them.

### *Material costs*

For many companies the most readily determinable part of production costs is the outlay for raw materials. A producer of electronic equipment, for example, knows what parts are needed for each assembly or subassembly. Similarly, a furniture maker can prepare a bill of materials identifying every board length and all the hardware required to turn out each item in his line.

And yet, even in such relatively simple cases, it is not possible to calculate material requirements in full until allowances are made for losses resulting from defects, mistakes, and machine waste which prior experience has conditioned the manufacturer to accept. Depending on the industry, some or all of four types of loss are possible:

1. *Rework* may consume considerable labor and overhead but usually results in a relatively small material cost. Refinishing, for example, may involve the application of an agent for removing the defective coat plus a duplication of finishing materials.

FIGURE 1

**MACHINE PRODUCTION STANDARDS**

**Cost Center 12—Calendering**

**Table of Running Times, in Hours per 1,000 Pounds**

| | GAUGE | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HAND | .005 | .006 | .007 | .008 | .009 | .010 | .011 | .012 | .013 | .014 | .015 | .016 |
| —5 | .27 | .29 | .31 | .32 | .34 | .36 | .38 | .40 | .41 | .43 | .44 | .46 |
| —4 | .27 | .29 | .31 | .33 | .35 | .36 | .38 | .40 | .42 | .44 | .46 | .47 |
| —3 | .28 | .30 | .32 | .33 | .35 | .37 | .39 | .41 | .42 | .44 | .46 | .48 |
| —2 | .29 | .31 | .33 | .34 | .36 | .38 | .40 | .42 | .43 | .45 | .47 | .49 |
| —1 | .29 | .31 | .33 | .35 | .37 | .38 | .40 | .42 | .44 | .46 | .48 | .50 |
| 0 | .30 | .32 | .34 | .35 | .37 | .39 | .41 | .43 | .44 | .46 | .48 | .50 |
| 1 | .31 | .33 | .35 | .36 | .38 | .40 | .42 | .44 | .45 | .47 | .49 | .51 |
| 2 | .31 | .33 | .35 | .37 | .39 | .40 | .42 | .44 | .46 | .48 | .50 | .52 |
| 3 | .32 | .34 | .36 | .37 | .39 | .41 | .43 | .45 | .47 | .48 | .50 | .52 |
| 4 | .33 | .35 | .37 | .38 | .40 | .42 | .44 | .46 | .47 | .49 | .51 | .53 |
| 5 | .33 | .35 | .37 | .39 | .41 | .42 | .44 | .46 | .48 | .50 | .52 | .54 |
| 6 | .34 | .36 | .38 | .39 | .41 | .43 | .45 | .47 | .49 | .50 | .52 | .54 |
| 7 | .35 | .37 | .39 | .40 | .42 | .44 | .46 | .48 | .50 | .51 | .53 | .55 |

NOTE: The data in this and all subsequent tables are contrived for illustrative purposes only, and bear no relation to the operating figures of any actual company.

Products may vary in the amount of rework they require. The feasibility of setting separate loss allowances for different product groups should be part of the budget studies.

2. *Second quality products* may sell over a wide range of prices. Some fortunate companies are able to unload seconds at retail with little or no loss of income. Others find a very limited market for their seconds, with severe markdowns the rule. In either case, expected losses are a proper subject for review in preparing the budget.

3. *Scrap* may have a small positive value, if it can be sold at all, or a negative value if the company must pay to have it carted away.

Some scrap needs no allowance because it is included in the initial allocation of materials. A manufacturer of containers, for example, plans to make boxes of certain dimensions from board of a stock size. Any scrap that results from trimming edges or punching out corners is included in the original unit cost of the board.

On the other hand, scrap normally resulting from damage to the board while machine adjustments are being made is a matter for control; a standard loss allowance can be set up. Similarly, in clothing manufacture, if gaps are created when patterns are traced on the markers that guide the cutter's knife, scrap resulting from this looseness in the markers is a proper subject for budgetary control.

Sometimes the percentage of rejects is a cost factor of major significance. This is true where the characteristics of an item are more or less uncontrollable in production and at the same time acceptable limits are set with relatively low tolerances for an important segment of sales, as in the semiconductor business. Then much more elaborate studies are required, including frequency distribution analysis of production results.

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4. *Shrinkage* may result from loss of moisture, as in meat packing; from actual shrinkage of material, as in some textile operations; or from unaccounted disappearance, as in the case of liquids or gases lost through drains, exhausts, leaky pipelines, and the like.

A realistic budget will include allowances for all the losses normally incurred by the business. These allowances must not be set haphazardly or as a perpetuation of past inefficiencies. The budget-making process should involve a study of each phase of operations and a determination of the amount of loss that is reasonable and tolerable.

Loss allowances, once set after careful study, should become part of the plan under which the business operates. Variances from these allowances should be reported regularly—and investigated and acted

upon. By building its pricing structure on costs that include these budgeted elements, a company can assure itself that budgeted margins are indeed being maintained.

One of the difficulties encountered in budgeting material costs for a full year is that prices rarely remain constant for that length of time. The techniques for segregating and reporting price variances are well known and will not be discussed here. A special situation that is worthy of mention exists in those businesses that deal with commodities. Erratic fluctuations in the prices paid for materials can make budgets difficult to interpret and even more difficult to relate to pricing decisions. A proper method of budgeting for such companies is to set prices for finished products and materials in such a manner as to arrive at a target net margin of revenue over material cost and to handle all other items in the customary fashion.

### *Direct labor costs*

In estimating the direct labor cost to produce an item, whether old or new, a measure of the time required for the completion of each processing operation must be sought. The compilation and use of such time standards for all processes is, of course, a necessary part of budgeting as well.

Whenever possible such standards should be based on time studies, although regression-line analysis of fixed and variable components can be used effectively. In any case, the acceptance of the standards by plant management and supervisory personnel is essential to successful control. The use of the same set of standards for both estimating and control, through the budget, is in many cases the only assurance a company has that its pricing is based on fact rather than fancy.

Direct labor costs may be calculated on units of work directly, especially in a piecework operation or in a uniform process. Or a dollar rate may be set for the cost of processing time or machine time, in which case the cost per unit will then be calculated for each item on the basis of its own standard production times.

Piece rates cannot be used for budgeting and cost estimating without adjustment for one or more of the following conditions:

1. Workers whose earnings fall below statutory minimum wages must be given "make-up pay" to bring them up to the minimum. There must be a general understanding as to the accounting treatment of these payments—whether they are included in direct labor cost or in plant overhead.

2. Changes in piece rates, whether as a result of improved work methods or in recognition of tightness or looseness in the old rates, obviously must result in revised cost estimates. Annual budgets cannot be amended every time a rate is changed, but these deviations should be recognized when variances from budget are analyzed.

3. Incentive bonuses frequently introduce a variable into the unit cost of an operation. Wherever it is practicable, bonus earnings should be traced to products. Some caution should be exercised, however.

For instance, if production is reported daily and a number of different items are typically included, it is sometimes not worthwhile to assign to individual products the amounts earned as incentive bonuses. Even when there is a daily record of actual time spent on individual items, the assignment of earned bonuses to these items is often doubtful because of variations in efficiency that are not product-related. Productivity during the first hour in the morning and the hour before the luncheon break may be well below that of a midmorning peak, and the afternoon may be characterized by a similar pattern. The pressure of a heavy backlog frequently spurs workers to higher levels of output than are normally maintained. Radical changes from job to job will have an adverse effect even on experienced operators while they are adjusting to the new tasks.

These fluctuations are observable characteristics of human behavior that have nothing to do with the products being run. They can give rise to gross errors wherever bonuses or other costs are attributed to individual short-run jobs on the basis of production rates attained.

4. Premium pay for overtime or second shift can also affect piece rates. The amount of premium pay expected to be incurred by each cost center at the level of activity anticipated in the forecast could be reflected in that cost center's direct labor rate or could be budgeted as specific overhead for the cost center.

5. Losses in production were discussed earlier. It is sufficient at this

FIGURE 2

Product Activity Forecast
(M Pounds)

| | PRODUCTS | | | | | |
|---|---|---|---|---|---|---|
| | A | B | C | D | E | Total |
| January 1, Inventory | 1,200 | 240 | 350 | 890 | 720 | 3,400 |
| January Production | 800 | 100 | 500 | 200 | 500 | 2,100 |
| January Sales | 650 | 110 | 260 | 400 | 390 | 1,810 |
| February 1, Inventory | 1,350 | 230 | 590 | 690 | 830 | 3,690 |
| February Production | 900 | 150 | 300 | 500 | 300 | 2,150 |
| February Sales | 800 | 140 | 330 | 490 | 490 | 2,250 |
| March 1, Inventory | 1,450 | 240 | 560 | 700 | 640 | 3,590 |
| March Production | 800 | 100 | 300 | 400 | 400 | 2,000 |
| March Sales | 830 | 150 | 350 | 520 | 500 | 2,350 |
| April 1, Inventory | 1,420 | 190 | 510 | 580 | 540 | 3,240 |

point merely to mention that a loss occurring after expenditure of effort on an item affects unit labor cost of finished production as well as unit material cost.

If compensation is based on hourly rates, additional factors bear on product costs. Individual differences in productivity, uneven performance, and varying time losses must all be averaged. The need for carefully constructed standards is obvious.

When an operation is machine-paced and several people are required to man the machine, a proper study of the cost of the operation must begin with a determination of the minimum number of persons actually required to perform all the crew tasks at peak efficiency. To neglect to make such a study is to abandon one of the primary objectives of budgeting, cost reduction through improved operations.

Machine speeds may vary over a range of values for one or more characteristics of each product. In the calendering of plastic film, for instance, thickness and density are determining influences on machine speeds. Both vary over wide ranges so that there are many possible combinations of them. It is helpful in cost estimating to have tables of production standards from which running times per 1,000 yards can be read for any given combination of thickness (gauge) and density (hand). Figure 1 on page 52 illustrates such a table for one machine.

### *Overhead costs*

Before overhead costs can be charged to products, they must first be gathered for all production cost centers. Appropriate bases, most often direct labor or machine hours, are then sought for allocation of each cost center's overhead to the operating times required for the production of the items processed there.

Needless to say, both the expenses and the bases for allocating them must be consistent with the planned level of activity. The first requirement, then, in calculating burden rates for cost centers is a sales forecast covering all products. From these sales, and from estimated beginning inventories and target inventories for the budget year, production requirements are projected. Figure 2 on page 53 illustrates a product activity forecast to derive production figures from sales estimates.

Figure 3 on this page translates monthly production data for several items from units of output to time requirements for a single cost center. At this point in the budget process it is well to consider the practicality of the plan, to note conditions of imbalance in the flow of work, under-utilization of equipment, overtime requirements, and the like. The departmental production forecasts may disclose a need for revision of the basic sales and manufacturing program.

The expected level of activity having been established for each cost center, the next step is to determine man-hour requirements and anticipated expenses of all kinds. Figure 4 on page 55 illustrates a projected cost of operations schedule for a single cost center. Assignable charges associated directly with the department and distributed charges apportioned among all production departments are included in a single schedule.

In deciding upon the basis to be employed in charging each department's overhead to the various products, it is important to select a relevant measure of the usage of the department's facilities. In a sewing plant where each machine is tended by an operator, direct labor is an appropriate basis for costing over-

FIGURE 3

**Cost Center 8—Blending**
**Production Forecast**

| Month and Product | Production M Pounds | Running Time Hrs./M lbs. | Running Time Hours | Average Lot Size M Lbs. | Number of Lots | Make-ready Time Hrs./Lot | Make-ready Time Hours | Total Hours Projected |
|---|---|---|---|---|---|---|---|---|
| January: | | | | | | | | |
| B | 100 | .40 | 40 | 50 | 2 | .4 | 1 | 41 |
| C | 500 | .35 | 175 | 100 | 5 | .8 | 4 | 179 |
| D | 200 | .20 | 40 | 100 | 2 | 1.0 | 2 | 42 |
| Total | | | 255 | | | | 7 | 262 |
| February: | | | | | | | | |
| B | 150 | .40 | 60 | 50 | 3 | .4 | 1 | 61 |
| C | 300 | .35 | 105 | 100 | 3 | .8 | 2 | 107 |
| D | 500 | .20 | 100 | 100 | 5 | 1.0 | 5 | 105 |
| Total | | | 265 | | | | 8 | 273 |
| March | | | | | | | | |
| B | 100 | .40 | 40 | 50 | 2 | .4 | 1 | 41 |
| C | 300 | .35 | 105 | 100 | 3 | .8 | 2 | 107 |
| D | 400 | .20 | 80 | 100 | 4 | 1.0 | 4 | 84 |
| Total | | | 225 | | | | 7 | 232 |
| TOTAL FOR THE YEAR | 9,000 | | | | | | | 3,500 |

head to the different styles. In a machine-paced operation like calendering, machine-hours of running time may be used. If different kinds of vegetable oil (not joint products) are being refined, all of them requiring the same amount of time and effort per pound processed, then cents per pound of output is a proper expression of a burden rate.

Applying burden on the basis of output pounds is not always a violation of conventional cost accounting precepts. Take, for example, the case of a company refining different kinds of vegetable oil (soybean, cottonseed, corn, palm kernel, etc.), on two types of facility, one continuous and the other a batch process. One facility will handle any of the oils with the same expenditure of time and effort. (In practice, this would be true of the other facility also, but in theory it need not be.) The two methods of refining incur equivalent out-of-pocket costs, so that the company may economically use either facility up to its full capacity or divide activity between them at will. There is, however, a difference in hourly burden rates between the facilities. In this situation it is both sound and useful to set a standard overhead absorption rate for refining, based on pounds of output.

A product cost estimate is illustrated in Figure 5 on page 56. Requirements for material, labor, and overhead are stated in pounds or hours for a 100,000-pound batch. Material costs are extended at standard prices, but two types of labor and overhead rates are employed: One is based on machine-hours and used for production cost centers; the other is based on pounds and used for material handling, warehousing, and the like. Finally, losses are shown as deductions from pounds of output before calculating net yield on which to base unit costs.

FIGURE 4

**Cost Center 8—Blending**
**Projected Cost of Operations**

| Production: 9,000 M lbs.<br>Productive time: 3,500 hours<br>Down-time allowance: 400 hours | Man Hours | Rate | Dollars | Dollars per Productive Hour |
|---|---|---|---|---|
| DIRECT LABOR: | | | | |
| Regular rates: | 3,900 | $3.00 | $11,700 | |
| | 3,900 | 2.75 | 10,725 | |
| | 3,900 | 2.25 | 8,775 | |
| | 2,100 | 1.75 | 3,675 | |
| Total at regular rates | 13,800 | $2.53 | $34,875 | |
| Premiums: | | | | |
| Shift | 5,200 | .10 | 520 | |
| Overtime | 690 | 1.26 | 870 | |
| Double time | | | | |
| Total direct labor | | | $36,265 | $10.36 |
| OVERHEAD: | | | | |
| Assignable overhead: | | | | |
| Indirect labor | | | $10,500 | |
| Holiday and vacation pay | | | 3,880 | |
| Fringe benefits | | | 6,100 | |
| Supplies | | | 3,600 | |
| Repairs and parts | | | 6,500 | |
| Depreciation—machinery | | | 4,100 | |
| Total assignable overhead | | | $34,680 | $9.91 |
| Distributed overhead: | | | | |
| Property taxes | | | $250 | |
| Insurance | | | 40 | |
| Building depreciation | | | 50 | |
| Maintenance | | | 900 | |
| Light and power | | | 3,800 | |
| Heat | | | 1,600 | |
| Plant administration | | | 1,300 | |
| Total distributed overhead | | | $7,940 | $2.27 |
| TOTAL OVERHEAD | | | $42,620 | $12.18 |

### *Control*

In the course of preparing a budget, a company reviews its operations and applies standards of performance to measure activities;

FIGURE 5

**Product X**

**Cost Estimate**

| | Number of Units | Cost per Unit | Production M Pounds | Cost in Dollars: Materials | Direct Labor | Plant Overhead |
|---|---|---|---|---|---|---|
| MATERIALS: | | | | | | |
| Resin | 50,000 lbs. | $ .15/lb. | | $7,500 | | |
| Plasticizer | 10,000 lbs. | .18/lb. | | 1,800 | | |
| Stabilizer | 5,000 lbs. | .20/lb. | | 1,000 | | |
| Filler | 30,000 lbs. | .03/lb. | | 900 | | |
| Lubricant | 2,000 lbs. | .10/lb. | | 200 | | |
| Color | 3,000 lbs. | .30/lb. | | 900 | | |
| Total Materials | | | 100M | $12,300 | | |
| PACKING MATERIALS: | | | | | | |
| Cores, paper, labels | 200 ea. | .06 | | 12 | | |
| LABOR & OVERHEAD: | | | | | | |
| Receiving and material handling | 100,000 lbs. | L. 3.15/M lbs.<br>O.H. 4.80/M lbs. | | | $315 | $480 |
| Blending | 22 hrs. | L. 10.36/hr.<br>O.H. 12.18/hr. | (2) | | 228 | 268 |
| Milling | 38 hrs. | L. 15.10/hr.<br>O.H. 20.40/hr. | (1) | | 574 | 775 |
| Calendering | 32 hrs. | L. 18.20/hr.<br>O.H. 6.35/hr. | (4) | | 582 | 203 |
| Finishing and wrapping | 8 hrs. | L. 3.55/hr.<br>O.H. 2.50/hr. | | | 28 | 20 |
| Warehouse and shipping | 93,000 lbs. | L. 3.15/M lbs.<br>O.H. 4.80/M lbs. | | | 293 | 446 |
| TOTALS | | | 93M | $12,312 | $2,020 | $2,192 |
| COST PER POUND | | | | $.1324 | $.0217 | $.0236 |

these standards are used in costing products and also in exercising control. It is to the control function that we now turn.

The extent to which budgeted standards will actually be utilized for control depends in large measure on the availability of relevant data to the persons responsible for maintaining efficiency. Relevant data include both actual and standard figures, expressed and presented in a manner that facilitates comparisons.

Inasmuch as operating personnel are concerned basically with statistical data (pounds, yards, man-hours, machine-hours), it is good practice to present budget comparisons in these units. A foreman responsible for the yield of a refining process needs to know the number of pounds processed and the percentage loss at actual and standard. He does not need to know the dollar value of the input. As a matter of fact, if the price is volatile, dollar values reported over a period of time will serve only to confuse him.

The reporting of statistical data for control has another advantage. Because data are ordinarily collected in the form of pounds, man-hours, etc., and then converted to dollars for accounting purposes, considerable reporting time is saved when the original data are used for control reports before conversion. Nowhere is promptness of greater importance than in control. This consideration by itself would be sufficient reason to prefer statistical reports over monetary reports for operating personnel.

There is still another advantage to be derived from statistical reporting where it is feasible. Because financial statements are normally prepared monthly, statistical data can be accumulated each month for a one-time conversion to dollars at the end. This will suffice for analyses of variances in connection with operating statements. Frequently substantial savings can be realized by use of a system that does not require price extensions for every withdrawal of material and that involves no distribution of payroll dollars until the end of each accounting period.

### *Conclusion*

In the normal course of running a business, occasions inevitably arise when it is necessary to predict or to estimate the cost of a product. The time must come, also, when costs are reviewed from the standpoint of efficiency and control. This review can best be accomplished by comparisons between results and measured standards. In fact, the aims of control and cost estimating can best be achieved by a budget program based on careful planning and prior operational studies followed by reporting feedback to discover areas of substandard performance.

# what people are writing about

## BOOKS

**The Future of Private Pensions**
by MERTON C. BERNSTEIN, *The Free Press of Glencoe, a Division of The Macmillan Company,* New York, 1964, 385 pages, $12.50.

*The nation's extensive and growing system of private pensions is designed to fill the gap between a respectable standard of living for the elderly and what Social Security and their individual savings can provide for them. As now constituted, it is not meeting that objective, Mr. Bernstein finds. He has a number of suggestions for redesign to assure that it will.*

Today about one out of every two workers in commerce and industry in the United States is covered by a privately financed pension plan. Just what does that statement mean? Under a grant from the Walter E. Meyer Research Institute of Law, the author, an attorney, arbitrator, and lecturer at the Yale Law School who has served as a pension consultant to the Treasury Department and Department of Health, Education and Welfare, set forth to find out.

After wading through a mass of statistics (and bemoaning the dearth of them on such vital subjects as job tenure), he reached these conclusions:

Pension plans actually cover only between a third and a quarter of the working population. Many groups are excluded — part-time, seasonal and other irregular workers; employees of many small organizations; and a high proportion of workers outside manufacturing, for example, in the service trades and agriculture. Furthermore, those excluded are often precisely those who most need pension protection—the low-skilled, the low-paid, women, and Negroes.

Many of those covered will never get the retirement checks they expect. Even among steady workers in nonfarm employment, only about

one-sixth to one-quarter will benefit. Voluntary separations, individual discharges, mass layoffs, the closing of plants, and the failure of enterprises will greatly reduce the number who can attain the years of continuous service required to qualify ultimately for pension payments.

Thus far the private pension plans benefit the higher-salaried employees most. Benefits decrease as one moves down the industrial ladder, with the lower-paid and more casual workers who change jobs most frequently receiving the least.

Even those who actually collect on their pension plans will, in a larger number of cases, get less than they now hope to receive. Tenure is the chief determinant of the size of pension benefits, and current turnover rates suggest that many employees will not have enough tenure in their final jobs to earn more than a minimal pension. Thus, the benefits paid, even when added to Social Security benefits and private savings, will not provide even a subsistence income for a large percentage of retired workers, still less for their widows.

Vesting provisions, benefit guarantees, and multi-employer plans all represent attempts to solve the problem. But all, Mr. Bernstein finds, have major shortcomings in practice.

Instead, Mr. Bernstein proposes a private clearing house system for transfer of pension rights among employers. Its operations would be managed by the government or by a consortium of private institutions now operating pension plans or by both. It would utilize such devices as "transfer values," now employed in Norway and regarded as feasible by British actuaries.

He also suggests other improvements:

Changes in federal tax laws to make employee contributions to pension plans tax-deductible and to require adequate funding as a condition of deductibility of employer contributions,

A partial employment retirement system under which employees who want to continue on a job may do so,

Methods of providing low-cost coverage for employees of small organizations and in the service trades,

Abandonment by unions of their opposition to contributory plans, which usually provide superior benefits and employee safeguards.

Mr. Bernstein's book is not intended, he emphasizes, as a criticism of those who initiate, administer, and guide retirement plans. "These people," he says, "are, by and large, quite cognizant of the possible shortcomings of their plans. They also are aware how much better their plans are now than they were a decade or more earlier. Many also feel that . . . they are unquestionably better than no plans at all. This and more I grant. . . . Nonetheless, this book is designed to question whether the improvements are good enough."

After reading Mr. Bernstein's provocative discussion, many readers will be inclined to agree with him. In any case, his arguments are worth the consideration of any executive or consultant involved in the design of pension plans.

**Overhead Cost Control** by PHIL CARROLL, *McGraw-Hill Book Company*, New York, 1964, 295 pages plus index, $8.50.

*In this concise, lively book a well-known industrial engineer takes a look at one of accountants' favorite subjects, attacking many of their shibboleths in the process. His views should be refreshing for accountants and useful for operating executives.*

In many large companies overhead costs are the largest single element of cost, and their trend is upward. This well-known fact is much bemoaned in industry, but, Mr. Carroll declares, the concern is not necessarily justified. Indeed, he says, the day of total automation, when all employees are overhead, may will be the millennium.

Much of the concern about overhead costs stems from what Mr. Carroll calls the "silly habit" of treating them as a per cent of direct labor. Actually, he points out, labor plus overhead is a sum. Additions to one may result in reductions from the other. What counts is the total.

Use of the overhead ratio as a measure of performance is essentially negative, Mr. Carroll asserts. Methods improvements designed to improve direct labor productivity cost money, and the more they save on direct labor the more they increase the overhead ratio. "From the opposite view, a drop in overhead ratio elicits applause. This can happen when monies are wasted in declines of direct labor productivity."

This does not mean, of course, that all increases in overhead are good. Systems adornments that do not control costs are wasteful. The trick is to evaluate overhead costs in terms of value received.

Mr. Carroll analyzes the influence exerted on overhead costs by such factors as definitions of direct labor, complexities and volumes of products, systems, productivities of people, customer cycles, and company goals, and tells how to use such techniques as time study and incentives to control them. His suggestions are concrete and practical; his style is simple and direct. His book should be useful to executives, accountants, engineers, and anyone else concerned with improving efficiency.

**Effective Use of Statistics in Accounting and Business** by JOHN B. O'HARA and RICHARD C. CLELLAND, *Holt, Rinehart and Winston, Inc.*, New York, 1964, $5.95 hard cover, $3.95 paper.

*A senior partner of Price Waterhouse & Co. and a University of Pennsylvania professor illustrate, through 33 case examples, how statistical techniques can provide solutions to problems in accounting and general management.*

In recent years statistics has won new prominence as a tool of management analysis and control. Yet many executives and accountants shy away from it because they are unfamiliar with the terminology and untrained in the techniques.

In this book the authors attempt

to show what can be done—and how to do it—with techniques no more advanced than those of algebra and elementary applied statistics. They are careful to explain terms and explain the rationale behind each method. They start with such simple arithmetic applications as ratio analysis, index numbers, the LIFO method of inventory valuation, and compound interest formulas before moving on to statistics.

Statistical applications covered include the use of means and standard deviations in determining average investment performance; regression and correlation analysis for profit analysis, establishing liability for product warranty, and devising sales incentives; random sampling and probability distribution for evaluation of clerical performance, estimating losses of customers, and taking inventory; and statistical techniques for inventory and production control. Each technique is demonstrated by realistic cases, some to be solved by the reader.

With a little effort, the businessman with only minimal background in mathematics can use this volume to wet his feet in—and whet his appetite for—a field of growing importance to management.

## MAGAZINES

**Converting the Accounts Receivable Function to Punched Cards** by HARVEY W. PROTZEL, *Journal of Machine Accounting*, April, 1964.

*The conversion of an accounting function to punched cards calls for careful study, detailed planning, and precise execution without which confusion, error, and delay are inevitable. An actual case history is described step by step to illustrate the merits of effective advance preparation.*

Before adopting any new methods, a company should determine what it would like to accomplish if a change were made. The subject company desired a more frequent aging of accounts receivable than the current quarterly report. Past due notices were not being prepared as often as was considered necessary or on any planned basis, and a reduction in operating costs was desired. A feasibility study was made to determine the best method to reach the predetermined goals.

A detailed report of the feasibility study contained recommendations for revising the system. It was stipulated that punched card equipment should be used since most of the information needed in the required cards could be obtained as a by-product of the current sales analysis application. The status of customer accounts would always be approximately three days more current than under the present system. An aged analysis would be produced twice each month, and at the same time past due notices could be prepared mechanically. Savings of approximately $1,000 per month should be realized, and one-time costs were estimated to be $800 for equipment and $3,000 to $4,000 for conversion. Naturally the decision was to proceed.

A plan of action was devised to accomplish the following steps: preparation of a detailed procedure manual to include changes required in related functions and design of all forms and cards; placement of orders for all new forms and cards and other supplies and equipment; education of personnel; and preparation of written conversion procedure. These steps were subdivided into detailed items to be performed and target dates were assigned for each action. Every step to be taken in advance of conversion was scheduled in order to gauge rate of progress.

The conversion procedure was planned as diligently as the operating procedure. Employees selected to supervise the operation were given a copy of the procedure and card forms, and classes were held to make certain there was complete understanding. Conversion was completed between the close of business on Friday and Monday morning, on schedule and without accident.

The punched card procedure is described in detail with illustrations of cards and report forms. The point is emphasized, however, that an attempt to install this procedure in another company in an identical manner would be a mistake. Each company must be studied individually and the procedure should be custom designed

BRUCE W. ROBERSON, CPA
*The University of Texas*

**Business Forecasting** by BYRON L. NEWTON, *Northwest Business Management*, Spring, 1964.

*For small businessmen who know little or nothing about business forecasting, this article summarizes some basic techniques.*

*Northwest Business Management* is a quarterly publication of the school of business and technology at Oregon State University. Its objective is to "render useful service to owners and managers of small- and medium-size business firms by presenting articles and information of a practical nature which, if applied . . . could lead to improved business performance."

This article seems to fit the objective of the magazine. It offers a short, elementary discussion of some procedures that have been found to be useful in making short-run forecasts of demand using published business indicators.

The author lists the major sources of these business indicators and, for each publication, describes the types of information it contains, where it can be obtained, and its price. Other sources of information on business trends are suggested.

Out of the multitude of business indicators, which one, or ones, does a businessman use for prediction of what is of interest to him—sales of his product? The following advice is given: "To be of value as an indicator, the relationship between the indicator series and the series to be predicted must be logical and must be one which reasonably can be expected to hold in the future."

The main part of the article deals with forecasting procedures. The author shows methods which can

be used to make a forecast of an annual aggregate (such as sales) based on (1) a coincident series (one whose movements through time tend to coincide with the series to be predicted); (2) a lead series (one which has the same pattern of movements as the series to be predicted, but whose "turning points" precede those of the series to be predicted by a known average period of time); (3) trends in the percentage of another aggregate, e.g., individual firm sales as a percentage of GNP; and (4) a two-variable linear regression model—the independent variable being any series. The reader should pay particular attention to (4) and heed the author's caution about the limitations of (3).

Most businessmen who now do any business forecasting through the use of economic time series will have gone beyond the techniques discussed in this article. However, for a businessman now making no conscious forecasts at all, awareness of this type of forecasting and the use of the methods discussed would probably represent an improvement.

Thus, while the article may disturb the statistician by its use of "freehand" techniques and by what is left unsaid, it fulfills the objective of its publisher. Application of its techniques would improve the performance of many small businesses.

JAMES WESLEY DESKINS
*The University of Texas*

**Profits from Abroad: What Management Has Learned About Overseas Operations** by GEORGE D. BRYSON, *Management Review*, March, 1964.

*The writer offers some general suggestions for the more effective organization and operation of export activities in order to take advantage of new foreign markets which offer potential profits. Increased industrialization in Europe, Latin America, and Japan has sharply improved the marketability of American machinery, methods, and products. Furthermore, a new familiarity with American styles has opened new markets for our products, with the lowering of trade barriers.*

An important consideration in export activities is the interest and enthusiasm of management. Mr. Bryson offers the reader the following questions to indicate the development of this interest:

How much do you personally know about the export sales and profits of the business?

How long has it been since you made a thorough analytical study of your export business and its prospects?

How often do you see and talk with your export manager?

What is your attitude toward traveling expenses for the export manager and his staff?

When did you last approve a budget for marketing and promotion in a foreign market?

What percentage of your firm's marketing investments last year went into foreign markets?

Information on the profitability of each product should also be available for both domestic and foreign markets.

Export activities should be tailored to an international market and should not necessarily conform to the same practices and policies as domestic operations. Although the manufacturer need not respond to every consumer whim, a sensitive response to consumer preferences is desirable.

The more abbreviated export organization includes the export director, secretary, and three managers. The manager of sales and service is responsible for the local agents in the world. Another manager handles order processing and translation, while the third, the accounting manager, is primarily assigned credit, billing, and collections. A more aggressive program, however, would require an additional manager, concentrating on marketing research, and three area supervisors, who report directly to the export director and are assigned to groups of countries for the better supervision of sales agents and for more effective promotion.

Under this plan, the order-processing manager performs a service function for the area supervisors. He can determine the causes for delays reported to him by the area supervisor. Proper corrective action could then be taken and improved service result.

The writer favors locating the accounting manager with the export department, delegating additional responsibility for budget projections, profitability estimates, and foreign exchange, besides collections, billing, and credit. Locating the accounting manager in the export department gives him more familiarity with its particular problems of pricing, control, etc. He could assist the area managers in the preparation of realistic budgets, especially since these managers are essentially salesmen, who are "notoriously bad budgeters."

Contracts and agreements for franchises, sales arrangements, etc., should be reviewed for timeliness and their applicability to local conditions. A review may reveal some contracts to be obsolete and no longer reporting an adequate profit.

Management must be willing to invest in foreign markets for the future. With this in mind, the sales and service managers should prepare a three-year budget, estimating the investment at the beginning and, under various volume assumptions, the length of time that it will take to recover this investment. Management should also have established targets for export sales for the next three, five, and ten years, with anticipation of increasing the percentage of total sales from the export sector of the business.

Credit standards take a different form in many foreign countries from those in the U. S. and therefore, foreign credit policy should be distinguished from the domestic. With foreign credit responsibility assigned to an export employee, he could organize all the factors relating to foreign sales to facilitate the most intelligent decisions.

Billing and collections should be

as close to the sales agents as possible, to clear up misunderstandings and arrange for the collection of problem accounts. If central billing is used, the export manager should control the flow of materials to and from the machines.

CHARLES CARPENTER, CPA
*University of Illinois*

**A Comparison between the Discounted Cash Flow Model and a Model Which Assumes an Explicit Reinvestment Rate for the Uniform Income Flow Case** by JOHN R. CANADA, *The Engineering Economist*, Spring, 1964.

*In this article, John R. Canada explores the differences between the calculated rates of return of the discounted cash flow model and an explicit reinvestment model. The calculated rates of return for the discounted cash flow model are plotted against the rates of return of the explicit return model for reinvestment rates of 0, 6, 12, and 20% and for salvage values of 0, 50, and 100% of original cost.*

Three plots are presented in the report: one for a project life of two years, one for ten years, and one for 20 years. In addition, the author has developed a general mathematical relationship between the rates of return of the two models.

Figure 4, which is a plot of the "Relative Magnitude of Deviation, Discounted Cash Flow Model Compared to Explicit Reinvestment Model (for a) Ten Year Project Life" brings home the general theme of the paper: "that the reinvestment assumption of the discounted cash flow model may well be inappropriate in the general case, and hence it would be wise to use the explicit reinvestment model so as to avoid a potential pitfall." Canada's point is well taken since the discounted cash flow model implicitly assumes that the cash flow from one project is reinvested in the firm at the rate of return calculated for the project under study. In many cases this assumption is not realistic, and hence the return that the company expects to earn from the cash flow should be explicitly recognized by the model. If the analyst wishes to adopt the model that Canada employs in his paper, it is possible to determine the effect of the discounted cash flow reinvestment assumption by referring to one of the graphs or to the general mathematical relationship between the calculated return of the two models.

The rate of return of the explicit reinvestment model employed in the article is defined as the cash receipts minus cash disbursements per year *less* the uniform annual sinking fund depreciation charge divided by the investment in the project. Thus, the model implicitly assumes that only the depreciation flow is reinvested at the reinvestment rate. The earnings imputed to the depreciation flows are credited to the cash profits —i.e., the cash receipts less the cash disbursements—assigned to the project in the form of the reduced depreciation charges of the sinking fund method. Since most companies reinvest a portion of the cash profits as well as all the cash flow from depreciation, the calculated return of the reinvestment model of the article could be adequately described as the minimum reinvestment return.

However, since the model fails to discount the cash profits, the term minimum reinvestment return is not descriptive in all cases. Where the projected life is long and the reinvestment rate is relatively high, the calculated return of the explicit reinvestment model of Canada's article can be overstated. With this point in mind, one can see that Canada's comparisons and conclusions would have been more meaningful and conclusive if the cash profits *less* the charge for sinking fund depreciation had been discounted.

Without too much difficulty one can redefine the explicit reinvestment model so as to incorporate the discounting of the cash streams. The derivation of the relationship between the calculated returns of the two models (pp. 6-8) is sufficiently detailed to permit the analyst to modify the mathematical relationship between the models so as to incorporate a discounted form of the explicit reinvestment model employed in the article.

JOSEPH F. SCHIRGER
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**The Role of Small Business Equipment** by T. J. DIGGORY, *The Canadian Chartered Accountant*, May, 1964.

*Nonelectronic equipment still has a major role to play in office operations. This article emphasizes its importance to large and small companies.*

The highly publicized electronic computer has overshadowed small business equipment. In this article Mr. Diggory re-emphasizes the vital role played by more prosaic machines in paperwork management.

Small business equipment is defined as "the machinery, devices, and aids used in the office which are, for the most part, operator-oriented and generally of a mechanical or electro-mechanical rather than electronic nature." Such equipment is an important and integral part of all total systems, regardless of the size and sophistication of the company involved.

A periodic analysis of systems, including an appraisal of the adequacy of the equipment, is a vital aspect of paperwork management. Executives should be constantly on the alert for indications of systems weaknesses before they develop into critical problems.

The systems review should be based on the principles of work simplification. Only after a systematic review and revision of present systems should the application of new mechanical aids and devices be considered.

The selection process for new equipment may start with suppliers' proposals, but management should not rely entirely on this source. A personal study, taking into consideration such factors as the present system and future needs, reliability of the equipment and the supplier, and the impact of the mechanical devices on the

office personnel, is essential. On the basis of such a study the various suppliers' proposals can be evaluated and a decision reached.

A systematic study of the type outlined by the author will help to avoid the pitfalls he mentions—mechanization where no particular advantage has been demonstrated, choice of equipment which is too narrow or too broad for present and future needs, and over-reliance on suppliers' package systems studies.

This timely article focuses attention on an aspect of paperwork management that has been neglected in recent years. The systems manager and the practitioner should not overlook the potential of small business equipment and should keep abreast of new developments in the field.

DONALD E. STONE
*The University of Wisconsin*

**Risk Analysis in Capital Investment** by DAVID B. HERTZ, *Harvard Business Review,* January-February, 1964.

*It's hard to get businessmen very excited about the dispute over the best way to calculate the return on investment for capital projects. They realize that the unreliability of the data that go into the various formulas—forecasts of sales and costs—is a much bigger problem. This article outlines a way, based on probability mathematics, to take these elements of uncertainty into account in the calculations.*

The mathematical precision with which the time-adjusted rate of return of a capital investment can be calculated has little value without critical evaluation of the assumptions on which the data used in the formula are based. Each one of the many variables—such as anticipated sales prices and volumes—is subject to uncertainty. The decision maker needs to know the effects that these uncertainties have on the return he is likely to achieve. Mr. Hertz suggests the use of statistics, namely the application of subjective probabilities to each variable in order to quantify the element of risk at every anticipated rate of return.

A simulation of the way these factors may combine as the future unfolds is the key to extracting the maximum information from the available forecasts. The analysis requires three steps:

1. Estimate the range of values for each of the variables entering into the decision. For each value determine its probability of occurrence.

2. Select at random one value for each variable and combine these values to compute one possible rate of return.

3. Do this over and over again to define and evaluate the odds for and against the recurrence of each possible rate of return. The average expectation will be the average of the values of all outcomes with each rate weighted by its probability of occurrence. The variability of outcome values from the average should also be determined, as management would presumably prefer lower variability for the same return if given the choice.

In the process of accumulating data, it is necessary to probe and question each of the respective experts involved; e.g., the market researchers should be able to state whether the estimated selling price can be considered certain or whether the selling price should be estimated to lie within a definite and logical range. In the typical decision the range is usually ignored.

However, it is easier to estimate accurately a range than a specific single value. Historical data can be utilized as a guide to possible variations in selling prices and costs. For those variables which have no history (as in the case of a new product) the person making the estimate should be more willing to prepare a range of relevant data and its probability than to submit one figure. Additionally, it should be emphasized, the less certainty there is to an "average" estimate, the more important it is to consider the relevant range.

For companies that already put a lot of effort into calculating projected rates of return, this additional probability analysis adds little to the work load. With the aid of a computer this simulation method produced in one trial "3,600 discounted cash flow calculations, each based on a selection of nine variables within two minutes at a cost of $15 for computer time," Mr. Hertz reports. The result should be a more accurate portrayal of risks and possible rewards.

SHIRLEY M. ARBESFELD
*New York University*

**Internal Pricing in Firms When There Are Costs of Using an Outside Market** by J. R. GOULD, *The Journal of Business,* January, 1964.

*This article is concerned with the problem of pricing intracompany transfers of intermediate products for which market prices are available. For those products traded in a perfectly competitive outside market, where both the buying and selling divisions face the same price, the transfer price should merely be the market price. But, in this article, J. R. Gould addresses himself to the more formidable problem of transfer pricing in those situations where there is a cost of using the outside market; i.e., a difference exists between the price the buyer division would have to pay and the price the seller division could receive for the intermediate product. This difference may be caused by transportation costs when the integrated firm is located some distance from the outside market. Gould argues that the transfer price will always be either the buying price, the selling price, or some amount between the two, and that it can be determined.*

The article is divided into the discussion of three problems of transfer pricing. In Part One, the author discusses the determination of individual division output policies which will maximize the firm's over-all profits. This determination may differ depending on the relative values of the buying price, the selling price, and the price at which MC equals NMR (MC is the marginal cost curve of producing the intermediate product in the selling division; NMR

is the net marginal revenue curve derived by deducting the marginal cost curve of processing the intermediate product in the buying division from the marginal revenue curve of the final product).

In Part Two, Gould points out the circumstances under which knowledge of the selling, buying, and transfer price will and will not permit decision making as to the possible abandonment of either the buying or selling divisions.

Part Three concerns the practical procedures for determining the transfer price. This determination depends somewhat on the relative scales of operation for the divisions. For example, if the scale of operations is much greater in the selling division than in the buying division, the selling division will always have a surplus to sell on the outside market. Therefore, central management should set the transfer price at the price the seller can obtain on the market. This will permit both divisions to operate at levels which will maximize their own profit, and also to maximize company-wide profit.

The author concludes with a warning of the weakness in judging divisions by their profits and at the same time permitting them to take part in determining the transfer prices upon which division profit is based. The importance of this weakness depends on the objectives involved in using transfer prices.

In summary, the author has attempted to provide some useful guidelines for the solution of a realistic problem situation.

J. F. Antonio, CPA
*University of Illinois*

**Trimming Data Processing Waste** by Henry Schindall, *Administrative Management*, March, 1964.

*The author suggests some ways to keep a computer installation from increasing rather than cutting office costs.*

For some companies the installation of automatic data processing equipment results in a sharp increase in over-all office costs. This increase is due in part to the cost of operating the data center and in part to the fact that other departments find they need more people and office machines to keep up with the new equipment. Computers have the ability to digest enormous quantities of data and to pour out great numbers of elaborate, detailed reports.

The first step in controlling the cost of operating the data center is to make sure that the reports that flow from it are used. Too often reports are prepared because the equipment is available, not because the reports are needed. Mindful of the high cost of data processing machines, management is afraid it is not getting its money's worth if the equipment is not used full time.

Management should list all the reports prepared by the data processing center and rank them according to importance. Reports that are not used and reports that add more costs than benefits should be eliminated, and those that are used should be revised and synchronized, omitting all unnecessary detail. It is better for the equipment to be idle part of the time than kept busy by preparing reports that are not worth the time and effort that go into them.

By cutting down on the number of reports prepared management also cuts down on the processing center's need for data. This permits departments that supply the center with information to operate efficiently by concentrating on supplying only useful data for needed reports.

To cut down on idle time, some companies permit such departments as research, engineering, and marketing to use the automatic data processing equipment for special projects. These projects, too, should be evaluated in terms of costs and benefits. Those that are retained should be assigned priorities and scheduled so as to utilize the equipment most efficiently.

In a punched card installation the main problem is labor cost. Not all accounting areas need 100 per cent verification. To prevent unnecessary duplication of effort, management should determine the type and amount of error that can be tolerated and the point at which it would be less expensive to correct the errors after they occur than to prevent them.

Now that more and more small companies are installing automatic data processing systems, the problems discussed and the recommendations made are particularly timely. Management must learn to use this equipment efficiently and effectively. It must not be overawed by the equipment's cost or capabilities nor should it treat the equipment as a toy. It should be recognized for what it is—a tool to be used to enable management to attain its goals or objectives.

Arthur V. Corr
*New York University*

**On a Basic Class of Multi-Item Inventory Problems** by Joseph L. Balintfy, *Management Science*, January, 1964.

*This article suggests an approach to an analysis of that class of random multi-item inventory problems where joint orders of several items may save part of the set-up cost.*

In the study of multi-item inventory problems, little attention has been given to the nature of interaction among items or the effects of certain combination orders. Results of individual order policies (separable multi-item inventory systems) have long been known. While the calculation of optimum order quantities and time periods for each item has the obvious drawback that the effects of interaction among inventory items are disregarded, this technique does offer the maximum flexibility in system design. Such policies permit the selection of the individually best models for each single item and the modification of individual models whenever necessary.

The decision rule proposed in this article to aid in obtaining the demonstrated benefits of a joint-order policy is based upon the single operative rule applied to individual order policies. Hence, the author

claims, it retains many of the advantages of individual order policies, and at the same time yields a saving in set-up cost by permitting joint ordering.

The orders in the system are triggered by the inventory level of individual items. For every item a "can-order" level is defined. The rule would then say that whenever an order for a particular item must be issued, the inventory level of the rest of the items will be checked and all items which are in the range between the reorder point and the can-order point will be ordered jointly.

This technique, the author concedes, is subject to several severe limitations. In his analysis the author makes the following assumptions: (1) All of the items in the inventory have identical and constant set-up costs; (2) not all of the set-up cost may be saved by following a policy of joint orders; (3) the carrying cost of each item in inventory is identical and constant; and (4) the optimum order quantity for each item is identical and constant. Additionally, the reorder period (not constant) is considered to be a negative exponentially distributed random variable.

These assumptions, except for the last one, were made for the purpose of exposition and because of analytical limitations in demonstrating the random joint-order policy. Professor Balintfy was forced to make the last assumption because of the current state of the art in solving machine interference-type multi-channel queueing problems. The assumption is made to make it possible to compute both optimum time periods and cost differentials due to the joint-order policy. (A FORTRAN program for this calculation is available at the Tulane Computer Center, New Orleans.)

Relaxation of these assumptions is necessary for the treatment of most practical problems, i.e., machine interference problems with general service time distribution, non-Poisson arrivals, and different arrival rates in different channels. While no analytical solutions have yet been found for these problems, Professor Balintfy does suggest two alternatives. Queueing problems are not extremely sensitive to slight changes in the slope of the distribution, and unscheduled activities tend to approximate Poisson processes. Granting this observation, the results presented may be taken as an indication of those to be derived in the general case. Alternatively, the determination of optimum reorder ranges may be attempted through the use of simulation techniques. No substantial work taking this approach has yet been published.

MYRON URETSKY
*The Ohio State University*

**Responsibility Accounting and Reporting** by PHILIP CREIGHTON, *Cost and Management,* January, 1964.

*Responsibility accounting is "a system of accumulating costs and revenues and of reporting thereon which reflects the activity of each supervisor and executive charged with any responsibility." Essentially, it is a method of charging an executive or supervisor for those costs for which he is responsible. This is based on the idea that numerous responsibility centers exist in a business firm with a particular individual as the focus of this responsibility center.*

The technical features of responsibility accounting are as follows:

1. Each responsibility center is charged or credited with *only* those costs and revenues for which it is solely responsible.
2. There are no prorations of any income or expense items.
3. This system of accounting reports is fully integrated into the general financial accounting system.

This results in reports which reflect an individual executive's activity for the period under review and show how effectively he handled his particular responsibilities.

To make sure that each executive is charged only with those figures about which he can do something, from the lowest-level supervisors' reports only the totals are carried upward to the next executive's reports. From his reports, in turn, only totals are reported upward. Each executive's own controllable costs are added to the totals which have passed upward and thus each report distinguishes between controllable and uncontrollable costs. This breakdown of costs also helps to keep executives out of each other's business.

Successful responsibility accounting requires:

1. *Support of top management.* This is absolutely necessary because "RA" is an expensive method of reporting. Initially, "RA" may look like another attempt of management to police the work of operating executives and may generate opposition.
2. *Support and understanding of supervisors.* Because of possible opposition from the executives who are to use "RA," it must be thoroughly explained and accepted in advance. The executives and supervisors must be shown that it is to their advantage to use "RA" as a means of gaining control over their operations.
3. *Good budgets.* There is no reason for recording the discharge of executive responsibility if no one knows just what responsibility an executive was charged with.
4. *A progressive management climate.* "RA" is a means of eventually developing and motivating executives and supervisors through self-discipline. It should not be used as a method for securing top management control.

"RA" requires that all costs and revenues be someone's responsibility. Only in such cases can it then be useful to the organization. Such allocation of responsibility is present only in mature organizations.

Mr. Creighton's article strongly points out the advantages of using responsibility accounting to assist an executive to determine his own efficiency and establish a standard for measuring his performance.

JOHN R. CURRY
*The University of Texas*

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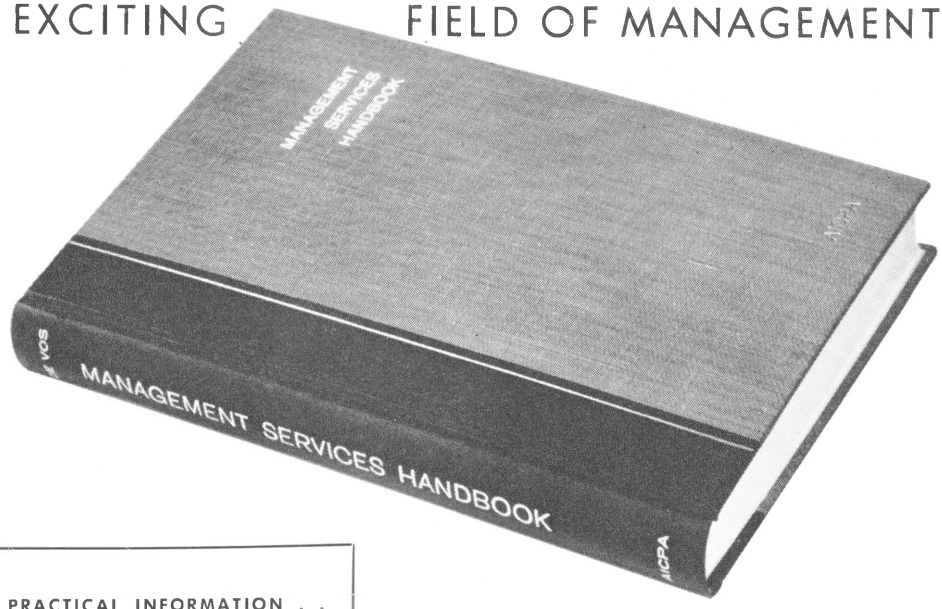


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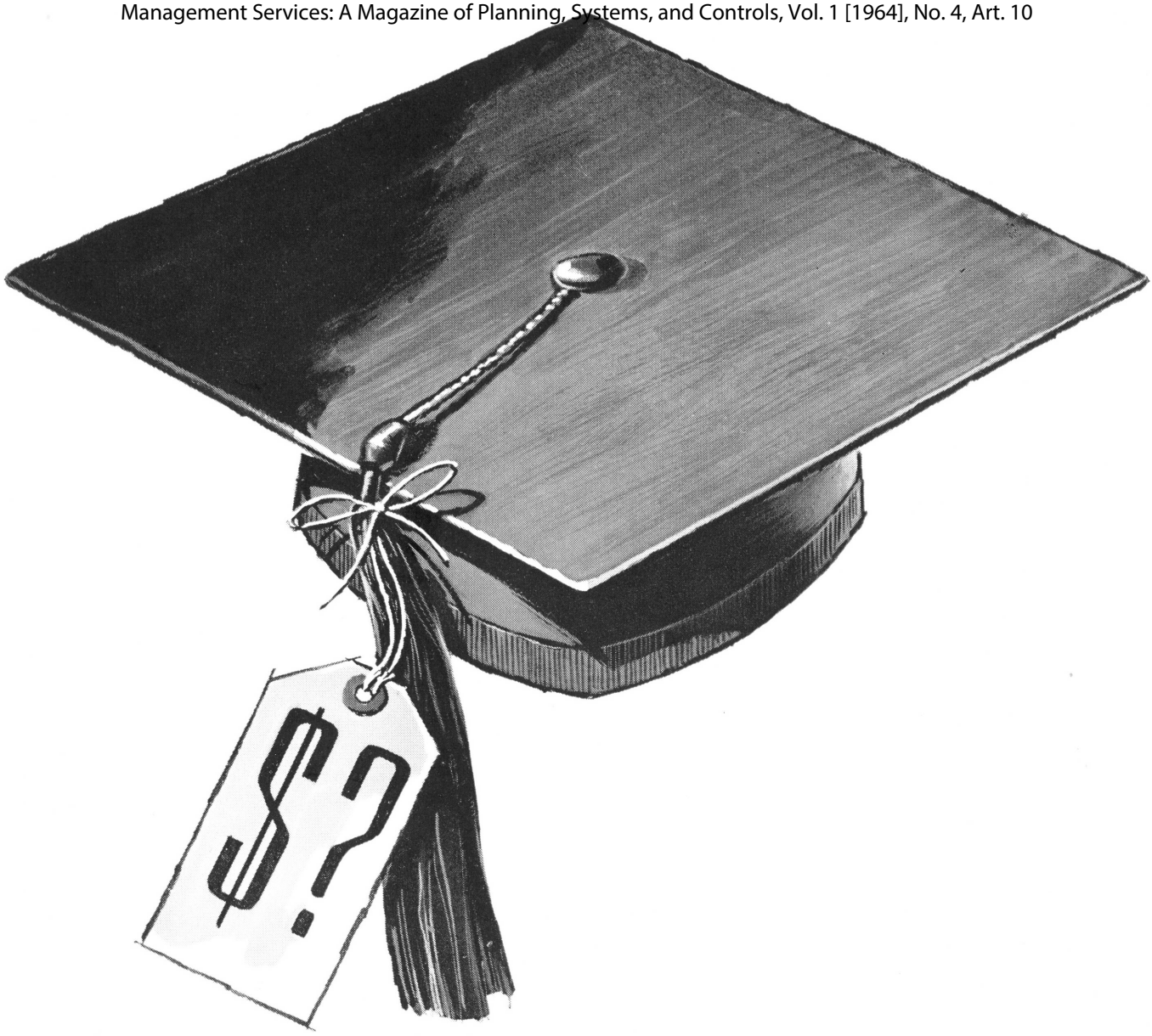


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