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

Volume 6 | Number 1 Article 9

1-1969

What People Are Writing About

Elba F. Baskin

Davil E. Remark

what people are writing about

BOOKS

Top Management by PAUL E. HOLDEN, CARLTON A. PEDERSON, and GAYTON E. GERMANE, McGraw-Hill Book Company, New York, 1968, 263 pages, $8.95.

This book, the result of an intensive study of fifteen leading corporations, provides a highly condensed but valuable review of their management practices.

Top Management Organization and Control by Paul E. Holden, Lounsberry S. Fish, and Hubert L. Smith has been a management classic for years. From it a host of aspiring managers learned not how management should be conducted in theory but how it actually is conducted in practice in the nation's largest corporations.

That book was written more than 25 years ago, however, and much has changed since then. Hence this new volume, essentially a follow-up to the first one. Through personal interviews with 268 executives in 15 companies that among them account for 8 per cent of gross national product, the authors studied top management policies and practices in 15 "major top management involvement areas." They also sought to pinpoint major changes in top management policies and practices since the time of the earlier study and to forecast probable trends.

The areas of "involvement" were overall control; management of corporate income; long-range planning; centralization versus decentralization; committees; composition, functions, and use of boards of directors; research and development; product-line direction and control; mergers and acquisitions; international operations; management information systems; external relations; employee relations; and development of executive personnel. The last chapter analyzes the

educational and career patterns of 310 high-level executives of the participating companies.

In 263 pages it is impossible to pack anything resembling a manual of procedure. The reader will not, for example, learn how to set up a budget system. But he will learn that budgetary control is used by every company studied—compared to only half of those studied 25 years ago.

Decentralization

Many of the trends reported in this book are interesting, and some are surprising. For example, despite the clear and frequently reported trend toward centralization of data processing, all the executives interviewed felt that the computer would lead to more rather than less decentralization of management and that middle management would not be reduced either in authority or in numbers.

Some other trends:

In organization, the newest positions to become popular are those of product manager, project manager, and program manager. Organization planning departments, once a major fad in large companies, are on the way out.

Long-range planning

The current fad is long-range planning. Today planning for five years ahead is commonplace, at least among this select group of companies; 25 years ago many of the largest companies did not plan in detail even for the ensuing fiscal year.

Formal executive selection and development programs, almost nonexistent 25 years ago, are now standard, although they vary greatly among companies.

The "road to the top" followed by the 310 top management executives covered in this study showed few surprises, however. These men came up for the most part through operating rather than staff positions. By far the largest number had technical training in science or engineering and spent the bulk of their careers in engineering or production.

For those (surely including accountants and consultants) who want an overview of the best in current management practice, this is an important book. It will probably join or replace its predecessor on management's shelf of classics.

The Management of Capital Expenditures by ROBERT G. MURDICK and DONALD D. DEMING, McGraw-Hill Book Company, New York, 1968, 297 pages, $12.95.

The publisher describes this book as "the first truly practical guide to the management of capital expenditures." While that may be an exaggeration, the work is unusual in the way it combines analytical theory and procedural detail.

Most books on capital investment management focus, often in abstruse mathematical terms, on the various formulas for evaluating proposed investment alternatives. Those that emphasize actual company practice tend to get bogged down in the dreary details of who approves what and who is on what committees. This book is a novelty in that it manages to combine the approaches without sacrificing concreteness or common sense.

Its focus is on capital investment as a part of company planning, not on capital investment as an isolated problem. Evaluation techniques are hardly mentioned in the first fifth of the book, yet they are discussed in adequate detail.

The opening chapters present capital investment in the perspective of the business as a whole—how the capital investment problem arises—and from the perspective of top management. Factors that influence investment decisions —such as taxes, competitors, financing—are analyzed. A relatively unusual chapter tells where the analyst should go to get the data for his analysis.

Then comes the discussion of evaluation methods, including a discussion of the use of probability techniques. Procedural chapters—on the step-by-step development of the capital budget and on control and auditing procedures—are followed by case studies illustrating the practices followed by TRW, Inc.; Corning Glass Works; the Merck Sharp & Dohme Division of Merck & Company; and an unidentified electric company. There is a wealth of exhibits from these and other companies showing forms for appropriation requests, equipment record cards, and the like.

For the specialist, a section of articles from other sources (chiefly *Factory* magazine) deals with more advanced concepts. One article presents an analytical and quantitative approach to measuring obsolescence; another deals with lease-or-buy analysis; and another suggests how to optimize the timing of equipment commitments. Several contributions deal with ways of simplifying economic evaluation calculations. The last article analyzes why the discounted cash flow and present value methods of analysis often produce different results.

The first question to be raised about any book on this subject is, "Why another one?" This book exudes an air of reality that somehow makes the question irrelevant.

Critical Path Analysis in Practice: Collected Papers on Project Control by GAIL THORNLEY (editor), Tavistock Press, London, (distributed in the United States by Barnes & Noble, Inc.) 152 pages, $6.75.

Network analysis is simple in theory but far from easy to apply. This book attempts to bridge that gap.

Network techniques such as PERT (Program Evaluation Review Technique) and CPM (Critical Path Method) have been outstandingly successful within their

relatively brief history of application, according to the editor of this volume, and it does not take much time to understand their fundamentals. However, the transition from theory to application demands considerable effort and skill. This book is intended to alert the newcomer to some of the problems likely to be encountered in managing a project control system by network methods.

Basic techniques

The first part of the book briefly describes the basic elements of the critical path method (known in Great Britain as CPA, for Critical Path Analysis) and reviews some of the areas in which it has been applied in the United Kingdom. Then problems of implementation are discussed, in particular, staffing requirements, choice of the first project, the level of detail desirable in a network diagram, and the use of computers.

Another section deals with the more complex varieties of CPM. Among them are PERT, here defined as CPM accompanied by the use of probabilistic time estimates; network-based cost control; and resource allocation techniques.

Large networks

The fourth section considers the special problems associated with very large networks, particularly the problems of organization and communication. A final section offers alternative approaches to the solution of problems usually handled by network methods—linear programing and transportation formulations. The appendices provide a glossary of standard terms and symbols, prepared by members of the Critical Path Analysis Study Group of the Operational Research Society and submitted to the British Standards Institute; a selective reading list; and a table of computer programs available in the United Kingdom.

Although this book is made up of papers by thirteen authors, most of them presented at one or another meeting of the study group, it is more unified than such collections typically are, and no huge gaps of coverage are evident. The book is aimed at operations research practitioners, but the style is simple enough to make it useful to anyone interested in critical path analysis.

Development of Information Systems: What Management Needs to Know by DONALD F. HEANY, The Ronald Press Company, New York, 1968, 421 pages, $9.

Although it is intended as a guide for the businessman who works with systems analysts, this volume is really more effective as a manual for the analyst himself.

The communications gap between businessmen and the information systems analysts who would like to serve them is a serious one. In this book Mr. Heany, a General Electric Company consultant, seeks to clear up management's misconceptions about computer-based information systems; explain what is involved in designing, programing, and running an information system; and call attention to the contributions executives can make to systems development. The book is an outgrowth of a text originally prepared for use in a GE financial management training program.

After a brief orientation section that defines terms and discusses information requirements in terms of the company's business environment, Mr. Heany tells in considerable detail how to design an information system, including the determination of data requirements; the detailing of the design; and the testing, implementation, documentation, and appraisal of the system.

He describes basic equipment available for data processing and data communication and offers a short course in programing, with emphasis on BASIC. He discusses how to organize and administer the systems activity, including scheduling of equipment use, and concludes with a review of progress in information systems development and a forecast of trends.

Appendices include an eight-page glossary of systems and computer terms and a bibliography. There is generous use of flow charts and the like for illustration.

The book's objective is a worthy one. However, the businessman reader is likely to find this volume telling him more than he really wants to know about the techniques of systems work and less than he wants to know about such broader issues as what information is needed to manage. Despite continual efforts to relate the material to general management's interests and responsibilities, the book remains something of a worm's eye view. For the would-be or less experienced systems analyst, it is a splendid guide.

Briefly listed

The History of Management Thought by CLAUDE S. GEORGE, JR., Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1968, 210 pages, $7.50 (clothbound), $3.95 (paperbound).

This book reviews the various schools of management theory and presents a chronological development of the major contributions to management thought, summarized in the form of a tabular continuum. The author concludes with an attempt to set forth a unified general theory of management. A 25-page bibliography of management literature is organized chronologically.

How to Get an Executive Job After 40 by CHARLES S. MINER, Collier Books, New York, 1968, 213 pages, $1.50 (paperbound).

This reprint of a 1963 book incorporates a strong promotional plug

for the Forty-Plus Clubs. It is full of sound advice, however, for the older—indeed, for any—executive job seeker.

Management Glossary by H. JOHANNSEN and A. B. ROBERTSON, edited by E. F. L. Brech, Longmans, Green and Co. Ltd., London, 1968, 146 pages, 30 shillings ($3.60).

"One of the roots of our lack of organization of management knowledge is the absence of any standardized and agreed terminology," the foreword to this book quotes a British management magazine. By proposing definitions of selected terms—fundamental terms used in management theory, significant terms from specialized functional areas, terms describing management techniques, and terms from allied disciplines closely associated with management—this work seeks to help clarify the language of the "science" of management.

Production and Inventory Control: Principles and Techniques by G. W. PLOSSL and O. W. WIGHT, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1967, 432 pages, $10.50.

Designed for use by the professional in industry, this study covers, and attempts to integrate, forecasting, economic lot size, materials control, inventory management, planning and control of production capacity, and production scheduling. Appendices explain such mathematical concepts as the economic order quantity and LIMIT (Lot-size Inventory Management Interpolation Technique).

Personal Resume Preparation by M. P. JAQUISH, John Wiley & Sons, Inc., 1968, 158 pages, $5.95.

The author, a technical editor who has written employment resumes professionally, uses the results of a survey of personnel directors to evaluate and tabulate the information necessary for competent preparation of a resume. Then he tells how to put the information into salable form. More than fifty sample resumes and cover letters are included.

Financial Information Systems: Selected Readings edited by JAMES B. BOWER, CPA, and WILLIAM R. WELKE, CPA, Houghton Mifflin Company, Boston, 1968, 408 pages, $5.50 (paperbound).

Although primarily designed for classroom use, this collection of 37 articles on information systems, total systems, accounting systems, organization for systems, computer systems, internal control, and systems techniques contains much material of interest to accountants and systems analysts. Many of the authors represent major accounting and consulting firms. Five of the articles originally appeared in this magazine.

Executives Under Fire by CHESTER BURGER, Collier Books, New York, 1968, 248 pages, $1.50 (paperbound).

Here reprinted in paperback, this book offers, in anecdote form, tips for survival in the upper levels of management. As its cover notes, it reads like a novel, but its advice is widely applicable.

Dynamic Costing by R. L. MARTINO, MDI Publications, Management Development Institute, Inc., 130 West Lancaster Avenue, Wayne, Pennsylvania, 19087, 1968, 145 pages, $19.95.

This book completes Dr. Martino's series on networking. (See M/S March-April '68, p. 58, and September-October '68, p. 56.) It adds cost control to the other elements of critical path analysis.

MAGAZINES

Analytical Techniques in Planning by DONALD J. SMALTER, *Long Range Planning Journal,* September, 1968 (Vol. 1, No. 1 of a new magazine published by Pergamon Press, Oxford, England, and Long Island City, New York).

The author, who is director of corporate strategic planning for International Minerals & Chemical Corporation, tells how his company uses advanced quantitative techniques in planning.

At International Minerals, Mr. Smalter says, planning is no longer accomplished by intuitive judgment. The tools now in use include planning check lists, logic sequence networks, program budgeting, system simulation, mathematical models, linear programing, and decision theory. In this article he describes the application of each of these.

Applications

Planning check lists cover goals and objectives; various aspects of the business environment (for the market research staff); fundamental strategies for product lines; and sales forecasting procedures.

Network diagrams have been used for many projects, for example, for the construction of a chemical plant in India and an ammonia plant in the Midwest.

Program budgeting is based on cost/benefits analyses rather than on negotiation between managers and their superiors. Planning is organized around a continuous planning/programing/budgeting sequence that produces each year a five-year plan that includes sales figures, costs, planned programs, and projected profit and loss statements. The whole process is computerized by means of a generalized data bank.

Simulation has been used to optimize the operations of a phosphate mine; the question was how best to mine the ore reserves in relation to market demand.

IMC's use of operations research models has progressed from operational studies aimed at solving tactical problems related to process

control and production scheduling to strategical analyses involving such problems as distribution optimization, investment alternatives, and strategic course of action alternatives. In making capital investment decisions probabilities and risks are calculated—by computer—for each proposed project.

ICM has used linear programing in plant site selection, operations optimization, distribution choices, product mix, and raw material choices. The company has an econometric model of the phosphate business that includes 25 geographical sources; 50 national markets; and a myriad of product possibilities. It is used, for example, to assess the value of new rock sources to ICM or its competitors.

Limited use has been made of decision theory, which is a way of establishing the utility value of taking a certain route (alternative) and determining the probability of attaining the goal by this route. A decision tree was developed to assess alternative strategies in the light of the future anticipated actions of competitors.

Although this article offers only a brief glimpse of some fascinating operations research applications, it is well worth the attention of anyone who is interested in the potentialities of these tools.

General Electric's Scientific Method for Helping Salesman Generate More Sales by Robert W. Baeder, *Business Management*, November, 1968.

This article describes a system of sales analysis that has enabled one of GE's industrial divisions to increase its salesmen's productivity by 20 per cent a year.

A salesman, Mr. Baeder points out, has only two things to sell: his product and his time. The way in which he relates one to the other determines his efficiency.

The formula described in this article offers a salesman a guide to the proper use of his time. GE began by picking a random sample of 208 customers served by some 70 salesmen. Each salesman was asked to estimate the sales potential of each of his customers and how much time he spent on each account. These estimates—plus actual sales of GE products to these customers—were fed into a computer, which, using the statistical technique of multiple regression, came up with an equation for the salesman to use in determining how much time he should spend on an account.

The formula is as follows: .96% (the fixed amount of time to be spent on any account, regardless of size or share of market) plus .0048 times the potential size of the account in thousands of dollars plus .14 times the market share the company obtains or plans to obtain equals the percentage of a man's total time that should be spent on a given account.

General applicability

The exact figures in the formula are based on GE's own business. However, as Mr. Baeder points out, the general nature of the formula and the basic way in which it was calculated should apply to nearly any company.

GE put the results into tabular form for all sales managers and showed them, at a series of seminars, how they could teach their salesmen to use the tables to increase their productivity.

Management use

Management also used the tables for its own purposes. To identify the customers that could not be sold profitably—and hence could be dropped—the division multiplied the sales for each account, according to potential size and GE's share of the market, by the average gross margin rate for an account; deducted the salesmen's and other variable expenses; and thus calculated the account's profitability—if any.

The technique also gave management a scientific yardstick for measurement of salesmen's performance. The results helped the management to take corrective action where it was indicated. It was able to give additional training to salesmen who seemed to need it and to distribute workloads more equitably. The studies showed, for example, that some high-volume salesmen actually should have been doing even better and that some low-volume salesmen were facing an almost impossible task because their accounts had so little potential.

Mr. Baeder recommends this analytical technique for recurring sales. It is less likely to be helpful, he says, where the business consists of a very few big-ticket items or in an industry where sales are made on personal friendships.

Some Thoughts on Management, Change and the Total System by Gordon H. Cowperthwaite, *Management Controls*, August, 1968.

Some comments on the problems caused by the changing environment facing corporate managers today and suggestions for the future direction of management in resolving these problems are presented in this article.

Mr. Cowperthwaite characterizes the environment within which corporate managers operate as one faced with "inevitable change." Changes are occurring in all areas, from technological and theoretical advances to increasing interaction between government and business.

The author suggests, "We do not always realize the pace of change and what we must do in order to insure that our companies are not only competitive but well managed." Management should always be concerned with leadership and fundamental management concepts. But another "challenge of change" facing managers lies in motivating,

guiding, and providing even greater challenges to the young college graduates who were reared in this volatile environment and who will be the managers of the future.

Systems approach

The author points out that changes in the environment have led management away from the traditional, narrow viewpoint of a segmented or departmentalized enterprise toward the adoption of a total systems approach. Computer technology has made feasible the creation of dynamic models that demonstrate the interaction of departments within a corporation under varying circumstances. A "new breed of management" will need to be developed to manage the total system. These managers will need the ability "to design and optimize the systems, to appreciate the needs of the whole, and to supply an integrated framework for decision making." The managers of today will not only have to discard some outmoded concepts but also must shoulder even greater responsibility in the area of executive development, the area where the "new breed" is discovered and nurtured.

Management development

In the author's view, development of people has been the "key to success" in the past and will continue to be the key in the future. Discovery of promising persons early in their careers and putting them into on-the-job training supplemented by formal training in new managerial concepts are essential steps. Another consideration in developing the "new breed" of management is compensation. Economic compensation may be subordinated to such non-economic concerns as the self-satisfaction derived from the achievement of both personal and corporate goals.

Managers of today should not be distressed by the development of new technology and theory or the competition of bright, young graduates. They should move to challenge these young graduates to be the managers of tomorrow by creating an environment free of outmoded practices of the past and incorporating the technology and theory of the present.

ELBA F. BASKIN
Michigan State University

The Line of Balance — A Management by Exception Tool by EFRAIM TURBAN, *The Journal of Industrial Engineering*, September, 1968.

This article describes a scheduling technique that is older than PERT but more widely adaptable.

Line of balance, described in detail in this article, is a technique for monitoring progress on various parts of a complex project. Operations that are critical—either because they represent potential bottlenecks or because they are relatively large in magnitude—are identified, and a progress study of them is prepared at given times during the actual progress of the job. Each operation is checked against some target, and those that fall short are pinpointed for further analysis. Thus LOB uses the principle of management by exception; the manager is encouraged to pay attention only to those activities that are both critical and behind schedule.

First, a chart of objectives is prepared, showing the cumulative delivery schedule of finished goods or services for the entire project in graphic form. The second step is the preparation of a flow process chart of all critical operations performed from receipt of raw materials to completion. The criticalness of activities is determined subjectively. Their lead times are calculated, and the operations and lead times are plotted in the form of a flow diagram called the program chart or plan of operation.

Periodically a progress chart is prepared showing the target for each operation (the line of balance) and the actual progress toward it. Then the chart is analyzed step by step and deviations are investigated further.

Line of balance has much in common with PERT (Program Evaluation Review Technique) and the two are often used together. The main distinction between them is that PERT is primarily for one-unit-type projects with a single completion date while LOB can be used to monitor a project involving many units to be shipped at certain intervals. Thus, PERT is used principally for research and development projects, while LOB is also suitable for continuous production.

LOB, this author notes, has been applied broadly by the United States Navy but seldom in industry. He suggests a number of possible reasons for this neglect:

LOB has not been widely publicized, and there has been no military pressure for its use as there has been with PERT. No "canned" computer programs for it are available. The forecasting and progress measurement required for its effective use are difficult.

Even so, Professor Turban feels, LOB is a tool that belongs in the kit of every progressive management. It deserves more attention than it has received.

The Information System Audit: A Control Technique for Managers by BENJAMIN CONWAY, *Management Review*, March, 1968.

Information systems are becoming so large, complex, and costly that they themselves are just as much in need of auditing as the operating systems they control. This article offers some suggestions.

Some basic principles of auditing information systems are outlined in this article by an IBM information systems consultant. Each system, he recommends, should be audited continuously from its in-

ception to the time it goes into operation by personnel not directly involved in the system's development and implementation. The audit team should be kept small; it should consist of a nucleus of one or two permanent members and a larger number of rotating members.

The audit should be conducted at each of four major stages in the development of the information system: the planning stage, the development stage, during implementation, and after installation. The objectives of the audit differ at each stage and so do the questions that should be asked; Mr. Conway spells them out.

Audit of the information system is particularly important, Mr. Conway notes, in companies that are widely spread geographically. The outline he offers can be applied to a company of any size or kind; it should be, he recommends, when the resources to be applied to the development of an information system or the resources that the system will affect and control become significant in relation to the company's total resources.

The Customer-Engineered Environment by GERALD G. FISCH, *Management Controls,* July, 1968.

Within the last several years merchandising has become much broader and larger in scale than was formerly the case. Associated problems have inevitably arisen, of which the two most significant appear to be high distribution costs and bad customer relations. These problems can be remedied, and this article suggests practical solutions.

Because of the complexity of retail store management, there is normally a division of the management function into merchandising, store superintendent, controller, and personnel groups, with coordination by the store manager. Solutions to merchandising problems have traditionally been formulated within this organizational framework, perhaps all too often at the expense of customer satisfaction.

Problems

According to the author, these organizational divisions have caused such critical factors as the time element—the interval between the arrival of the customers and the completed transaction—to be overlooked and undeservedly ignored. The customer-engineered environment seeks to optimize the conditions affecting the customer by transcending the typical organizational constraints and increasing the efficiency of the total environment. The techniques used can be applied to any level of store management after careful examination of the existing processes and the interrelated facilities.

The problems of customer engineering can be divided into three basic areas: the selling service itself, the physical environment, and the transaction procedures. The approaches to these problems should be integrated; the customer and store objectives should be reconciled; and the selection of merchandise and prices should be appropriate.

Analysis

The first step in analyzing the selling process is to determine the flux of customer arrivals. This varies with the season, sales promotion, type of merchandise offered, the time of day, etc., and thus establishes some type of rhythmic pattern. In order to operate efficiently, the store must measure this traffic and respond appropriately. Operations research computations, TASC charts (Transactions in relationship to Arrivals, Sales clerk capacity, and Contacts made), and determinations of the constants of customer waiting tolerances provide data useful in creating a pattern responsive to customer arrivals. All too often a store's TASC chart indicates such things as these:

Many more customers arriving than are contacted

A sizable gap between the number of contacts and transactions completed

A sales clerk capacity far in excess of number of arrivals or vice versa.

After determination of the problem areas in this context, the selling process can be facilitated in several ways: The sales clerk capacity may be adjusted; procedures may be simplified; training of personnel, communications, and layouts may be improved; and mechanization, automation, and de-skilling may be initiated or extended in scope. Finally, the customer-engineered environment, in order to be effective, must become a part of the management controls system of the store or chain. The author presents a workable method of attacking some very basic problems that have arisen in the expansion of retailing.

DAVIL E. REMARK
Michigan State University

Simulating a Cash Budget by EUGENE M. LERNER, *California Management Review,* Winter, 1968.

Simulation, the manipulation of a mathematical model to forecast the results of various actions, is a useful tool in many areas of management decision making. This author tells how to apply it to cash budgeting.

The two most widely used techniques of cash budgeting, the receipts-and-disbursements method and the adjusted-net-income method, both have one major deficiency, according to Dr. Lerner: They do not enable the financial manager to answer the important question, "How large a buffer stock of cash should the company keep on hand to protect itself from adverse cash drains?"

The reason is that these two methods require the financial manager to prepare a single estimate of each of the company's periodic cash

inflows and outlays. And, of course, few companies can predict these items accurately.

The solution, this author suggests, is for the financial manager to think of his receipts and disbursements not as single-valued figures known with certainty but as expected results subject to a margin of error. This introduction of probabilities makes it appropriate to use simulation, a computer trial and error technique that is well suited to the manipulation of large numbers of estimates in the absence of deterministic formulas.

Use of simulation

With simulation, Dr. Lerner points out, both the most likely value of an outcome and the margin of error associated with the estimate can be incorporated in the calculations. Thus, the financial manager can determine the size of the buffer stock of cash, liquidity, or line of credit that is needed to protect the company against uncertainties. He can predict the effect on cash of changes in company policies. And, by determining which corporate activities have the greatest effect on cash balances, he can concentrate his planning efforts on strategic activities.

By means of a hypothetical example the author shows how the financial manager can, after calculating a most likely estimate for each variable in his budget and a measure of variation about that value, simulate the cash budget on a monthly basis to determine both the expected change in cash during each month and the variation about this value. Utilizing both the mean and the standard deviation of the company's cash position, he then can calculate both the changes in the company's cash position through time and the buffer stock needed.

Then Dr. Lerner goes on to show how the simulation can be used to experiment with alternative feasible policies to see what effect they will have on the company's cash position. And, finally, he demonstrates how to use the simulation to determine the value of information. The model can be run to see how results would be changed if better data were available for specific inputs to the cash budget. Then the value of these results can be balanced against the cost of collecting the data.

The Economics of Sharing Computers by BERNHARD SCHWAB, *Harvard Business Review*, September-October, 1968.

A few years ago a company that wanted to be in style had to have its own computer. Now the fad is to share someone else's. For the individual company the choice should be made on economic grounds; the basic considerations are outlined in this article.

The sharing of a large computer by several users has recently gained widespread attention, this author notes. Much is written about service centers, time sharing, and even the "computer utility."

Should a company have its own computer, or should it buy time on a larger one somewhere else? Or should it do both? This author reviews the basic economic factors to be considered.

The sharing of a computer by several users has certain general economic advantages, the result of economies of scale. Computing power goes up more rapidly than cost as the size of a computer increases. Roughly, doubling the cost of the processor increases its computing power by two to the third power, or eight.

The sharing of a computer's memory also yields economies of scale. A big computer's large memory permits storage of more elaborate and complete programs than a small computer can spare the space for.

Computer sharing also, however, increases some other costs. Because users are generally at different physical locations, they will incur communication costs for the transmission of data back and forth to the computer. Furthermore, the cost of failure is higher for a shared computer since many users are affected. And, because of its complexity, a large computer is more likely to fail than a small one.

Time sharing

Another consideration is the choice, assuming use of a shared computer, between batch processing and time sharing. (This author defines a time-sharing system as "a system shared by several users, each of whom has a remote console which is directly connected to the system over communication lines; the system provides short response time to computation requests entailing short execution times by being able to commutate its facilities rapidly among the various users (program interrupt) and by using appropriate scheduling rules (time sharing)."

A time-sharing system is more complex—and hence more costly—than a batch-processing system. The principal added costs are for the more complex programing system, additional and more costly hardware, and overhead time (used for coordinating and "bookkeeping" activities). Although data are sparse, this author calculates that the total costs of a time-sharing system are at least twice those of a batch-processing system of similar processing capacity.

Generalizations

In general, Professor Schwab concludes, computer sharing is beneficial for solving problems that

involve a large amount of computation and low communication costs for input and output

require a large computer memory

require interaction between users

are interactive and are common in programing and in research and engineering applications

vary widely yet require little computation.

Computer sharing, he says, will

not be advantageous for problems that

carry a high penalty for failure (such as process control)

entail a low amount of computation, in terms of the number of operations, and high communication costs.

Time sharing, the author declares, will not be beneficial

for problems (particularly repetitive ones) whose processing can be scheduled easily and whose execution times are known in advance

for situations where the majority of problems have similar processing times

for problems to which immediate answers are not required

for problems entailing a large amount of computation.

In the end, Professor Schwab concludes, most companies will find it economically optimal to combine all three options—to have their own small systems and to have access to both time-sharing and batch-processing external systems for problems best suited to those media.

Project Planning Using Network Simulation by WILLIAM R. KING, *Pittsburgh Business Review*, September, 1968.

This article explains a technique that, the author feels, overcomes many of the deficiencies of PERT and other networking methods.

PERT (Program Evaluation and Review Technique) has been widely used in business and government. Yet recently, according to Professor King, there has been a shift away from PERT toward more basic critical path techniques.

This has occurred even though PERT, which combines the basic critical path method with assumed probability distributions to arrive at a probability distribution of project duration, is presumably more reliable than simple deterministic critical path analysis. The reason, of course, is an increasing doubt that PERT's probability distributions really do add reliability; many question the validity of the standard PERT assumptions.

For the most part, according to Professor King, these questions concern the validity of the PERT assumptions in two general areas:

the assumed distribution of activity duration

the method of combining activity durations to arrive at project duration output distributions.

Actually, according to this author, PERT gives consideration to uncertainty only in a superficial way because "it determines a unique critical path on the basis of the expected (mean) length of the path and then proceeds in exactly the fashion of deterministic critical path approach by focusing entirely on that path determined to be critical." But, because the activity durations are uncertain, the path selected may not actually be the critical one.

If these questionable assumptions could be avoided, Professor King points out, both the actual and the apparent validity of network planning would be enhanced.

As an alternative he proposes a technique called network simulation. It is based on the Monte Carlo simulated sampling technique, usable to analyze situations in which the distributions of some basic input quantities are known, it is desirable to know the distribution of output quantities derived from these inputs, and the way in which the outputs are derived from the inputs is so complex as to preclude the mathematical derivation of these output distributions.

The network model, Professor King suggests, is just such a situation. The activity duration distributions are known (assumed), and the principal output is a project duration distribution which is developed from the input distributions in a way whose mathematical theory, although known, is too complex to be practical.

With the Monte Carlo method, this author points out, an analyst can simulate many possible situations and combinations of circumstances that might arise from the assumed input distributions. Since many possible realizations of the project are simulated, the analyst can consider the effect of the possible criticality of alternative paths.

The author briefly describes the method of simulating a simple network problem. The sample problem he presents, he reports, was run through 100 replications. The result: The path that would have been deemed critical by PERT turned out to be critical only 48.7 per cent of the time; a different path was found to be critical 51.3 per cent of the time.

Network simulation, Professor King concludes, obviates both of the general areas of difficulty with PERT. He concedes that it requires a good deal of expensive computer time but argues that it may well be worth it.
