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The Analyst's Bookshelf

Joseph F. McCloskey, Editor

LETTER TO THE EDITOR

OPERATIONS RESEARCH ON THE CHINESE MAINLAND

Thomas L. Saaty

Office of Naval Research, Washington, D C

NEWs FROM different sources about Communist China has indicated rapid developments in industry, engineering, and operations research. The most significant operations-research news appeared in a translation (provided by the U S Publications Research Service) of an article published in a Chinese newspaper.

A striking feature of this article is the enthusiasm with which the individual comes to learn of the effectiveness of mathematical ideas that are used to improve the primitive methods to which he has been accustomed.

At low subsistence levels, use of operation research leads to direct improvements because it points out that things do not have to be done the same old way. It increases public faith in using rational thinking in local and global planning. It is also clear that, in a budding society, people try new ideas as if their lives depended on these ideas. Those who have been interested in total planning for underdeveloped countries may start (a tedious and not immediately rewarding task) by creating a favorable impression through scheduling ox-plows and providing optimal donkey loading, until modern materials are available and people are ready to use modern methods. This entails a better understanding of transition with which they can cope because they have become accustomed to co-operate with rudimentary operations-research methods. The transition will not be sudden.

The excerpts from the greatly reduced translation mentioned above have been interwoven to save space. The title, author, and source of the article are: WANG CHIEN-LIN, "Practical Application and Theoretical Discussion of Operations Research at Ch'u-Fou Normal College, Shantung," in *Jen-mun Jih-pao (People's Daily)*, Peiping, July 29, 1960, page 4.

To rectify the situation of insufficient transport strength against the flying development in industrial and agricultural production (we found continuously occurring on every transport line empty vehicles crossing each other and transport made in roundabout ways. One day, along the half kilometer road between the canal wharf and the Mei-chien Coal Construction Company alone, there were 160 empty vehicles crossing each other in the opposite direction) the Party Committee of the Ch'u-Fou Normal College decided to begin from the study and application of

the science of 'linear planning'. At that time, linear planning had only been introduced in the country for a short time, and the teachers gave lessons to the students with the only *Linear Planning Manual* available domestically, after which they all embarked on their projects. A group of 60 some sophomore students and their teacher arrived at the communications bureau, automobile transport group, and the automobile repair plant of the Chi-ning Special Office ('Chuan-shu').

The teacher and the students traveled almost the entire Ko-che and Chi-ning areas on motor vehicles along every highway to check cargo yards, sources of cargoes, their routing, and loading and unloading conditions, and they humbly solicited information from workers. After 20 some days they found 30 some problems in transportation such as the 'cross-flow' of empty vehicles and delays in loading and unloading. Later, in the transfer of goods and short-haul transport, they also found such irrational phenomena as the same kinds of goods being transported in the opposite directions and goods being transported 'along the limbs of a bow rather than its bowstring'. The teacher and students, dispatching personnel, and workers joined their efforts and utilized the 'diagrammatic operational method' and the 'tabulation operational method' in linear planning to carry out a rational reorganization of the methods of dispatching vehicles and transferring of goods, and important results were achieved.

After the Chi-ning City Transport Company had stabilized its mileage utilization rate of 'ti-p'ai' carts [a hand cart of some kind] at 73 per cent and that of horse carts improved to 96 per cent, the transport capacity increased each month was equivalent to a transportation charge of more than 570,000 yuan, and an increase of output equivalent to more than 6,860,000 yuan could be made for the state in a year. After the Bureau of Trade of the Chi-ning Special Office has carried out its reorganization on its series of plans covering the production, transportation, marketing, and storage of goods utilizing the linear-planning method, it will save for the state a transport charge of more than 2,220,000 yuan a year. These two savings added together are enough to purchase 606 'Liberation' make automobiles or 908 tractors, which are very impressive figures!

Linear planning has been utilized in transportation by motor vehicles, horse carts, 'ti-p'ai' carts, as well as boats in the Chi-ning area. Mileage utilization rate of motor cars has been improved by 12 per cent and that of boats from 40 to 79 per cent.

Of even greater practical significance, this normal college created a mathematics-subject with its own special features, called 'commune mathematics,' to meet the need of large-scale management of the people's communes. The teachers and students of the labor allocation and distribution group requested the captain of each small production unit to consider himself as one of the regular labor forces in the assignment of duties. These captains worked together with the commune members and in this manner they were able to understand clearly problems of labor assignment.

The teachers and students of the crop distribution group called old farmers, labor model workers, technical personnel, and cadres of small units for different types of round table conferences to understand soil distribution and local crops based on local soil conditions. When no problem existed, the teachers and students would repeatedly study the 'theory of actually doing things' [by Mao Tse Tung]. When there were a lot of materials to discuss, they would analyze the principal contradictions and the principal phases of contradictions according to Chairman Mao's theory on contradiction, and locate the internal relationship of these contradictions and solve them gradually.

Through rational arrangement of wheat yards, wheat harvesting tasks originally requiring 12 days were fulfilled in 6 days. The advantages of combined abacus calculation, charts, and cards, and the successful creation of 'slide rules' to help the multiplication and division of large numbers have improved the efficiency of calculation by 3-5 times. Under the direction of the Shantung Provincial Committee, these three practices have been universally promoted over the entire province. Seeing with their own eyes the pronounced effect of mathematics in its service to agricultural production, the large commune masses raise their voice of approval in unison.

Teachers and students of the linear-planning group made studies and analyses repeatedly dispatching personnel, and after more than 50 discussions, a planning problem in a new mathematical form was finally evolved, which they named as 'maximum and minimum problem of multiple functions'.

Having overcome this initial difficulty, the question that followed immediately was how to solve such a planning problem. This presented many difficulties to these young teachers and students. At this time, Secretary Cheng Yu-chiao of the General Party Branch of the mathematics department brought a letter by Party committee secretary Yu Hsun-shen of the Ministry [of Education] to the teachers and students, which said: "A smooth boulevard does not exist in scientific research. Victory is always accompanied by difficulties and to overcome difficulties is victory!" These words of the Party were like torches, lighting up the spark of wisdom of the teachers and students.

Theoretical knowledge was learned with renewed vigor and the copy of *Linear Planning Manual* was studied repeatedly. Problems were discussed together and a sophomore student suddenly suggested: "Is it possible to list the possible solutions of this planning question as a group of linear-planning problems, solve them one by one, and then select the best solution among them?"

In creating commune mathematics, they have altogether written 22 theses, arrived at 15 problems of theoretical nature, and written three books totalling over 400,000 words including the "Study and Application of Linear Planning."

Since March 1960 the local committee member of Chi-ning has called two district-wide on-the-spot conferences, and a special linear-planning office has been established with branch directing units in all the hsien and shih. In six hsien and shih including T'eng-hsien and Tsao-chuan, the first secretary of the Party committee personally took charge to include linear planning as one of the important items of technical revolution and had it systematized. In the last few months, 129 on-the-spot conferences or special training classes have been called or started by the three special districts, more than 24,000 persons have been trained, and over 1,890,000 industrial and agricultural masses have listened to reports on linear planning.

Once mathematics has been handed to the masses, its power is greatly demonstrated. Since the large industrial and agricultural masses and cadres love linear planning, they try to employ it in practical work. After the sewing group of T'eng-hsien's Sang-ts'un Commune learned linear planning, they discussed the feasibility of applying it in sewing. The result was that they employed the 'diagrammatic operational method' to carry out the rational cutting. Not only has working efficiency been improved but a very large saving in cloth has also resulted. The chief of planning department of the Bureau of Commerce of Chi-ning Special Office had a brainstorm of his own and applied linear planning to the improvement of statistical reports and tables. As a result, the work of correlating each month the statistical reports and tables of the entire district was completed six days ahead of schedule.

BOOKS

Reviews

EDGAR A. PESSEMIER, *The Management of Grocery Inventories in Supermarkets*, Bureau of Economic and Business Research, Washington State University, Pullman, Washington, 1960, 192 pages, \$2.00

ONE OF the problems in the operation of supermarkets is the allocation of shelf space for grocery items. Between 1950 and 1958 the number of grocery items handled in stores belonging to the Super Market Institute rose from 2,200 to 4,900. By now it may be as high as 6,000. As PESSEMIER says, with space limited in existing stores, and the cost of land and store construction rising steadily, the premium on store shelf space is growing every year.

Recognizing the magnitude and expense-significance of the space allocation problem, the author investigates three standard classes of methods used by supermarkets to control grocery stocks, proposes two innovations, and develops a manual for store personnel to use in implementing a control system.

The first class of grocery stock controls bases orders on past rates of ordering and on forecasts of coming events. In this class one of the specific methods that the author explores is the 'count and estimate system,' whereby the store personnel count the stock on hand of each item and refer to past orders before placing the new one. Although such methods are common, the author rightly notes that the level of efficiency with which the system operates is a function of the accuracy with which the store manager and his assistants count stocks and estimate sales. A small sampling of the results indicates that this level is not high.

In the second class of controls the orders are based on sales, or withdrawals from reserve stock, for the past week only, with this information again modified by forecasts of coming events. As the author notes, the 'reserve stock system' works well if shelf stock is at the desired level each time the order is written.

The third class of controls depends upon past rates of shipment from the warehouse, supplemented by forecasts of coming events. In use at one large chain, this system provides two orders per week for each store, the first of which is controlled from headquarters and is not prepared by store personnel. The second weekly order is a fill-in based on a 'count and estimate system.' Although the 'standard shipment system' provides two stock checks a week, better balanced inventories, and a time advantage for the warehouse, its success is dependent on the effectiveness of the fill-in order.

The two additional methods offered by Pessemier are the 'stock objective system' and the 'automated sales averaging system.' In the former a goal is set—a full shelf at the low point in inventory—while providing enough stock at all times for predicted sales. The ordering method under this plan is based on a six- or eight-weeks' experience of cases sold. The 'stock objective system,' according to the author, helps stores define a desired minimum stock for each item, provides easy-to-use guides for writing orders and facts to assist in merchandising, and leaves the responsibility for stock levels in the hands of store managers and warehouse merchandise personnel. The 'automated sales averaging system' takes the weekly

inventory counts by item for several weeks, computes a moving average each week, predicts a rate of sale based on this average and whatever other information the store manager has, selects a stock objective, and calculates an order for each item. To make automated sales-averaging effective, electronic equipment is necessary, but the author finds the proposed system both efficient and flexible.

The material is presented in a straightforward manner, with very little attention given to the underlying causes that have created the systems now in use. Pessemer is evidently directing his findings at grocery store managers who are responsible for the ordering function. There is considerable merit in such a presentation, because of the great cost of poor ordering and because, as the author notes, little formal training is given store personnel to assist them in the proper discharge of this responsibility.

In spite of the significance of the subject matter, however, ordering continues to be done on a most imperfect basis, and supermarkets still carry many slow-selling items. Some of these are in the store as a matter of policy, in the interests of complete assortments, for example, or because they carry unusually high unit markups. Others are there, however, in spite of the management's desire to be rid of them. It seems pertinent to ask whether the incompetence and poor training of the managers are primarily responsible for the continuance of this manifestly unsound condition. If, on the contrary, the success of space allocation is not importantly influenced by the manager's ordering skill, it may avail him or his store little to enhance this skill.

Retail merchandisers, whether in supermarkets or in other stores, traditionally have defied the application of quantitative analytical techniques in their day-to-day buying decisions. The failure of scientific disciplines to gain a foothold in merchandising—as distinct from operating, personnel, and controllers' functions in retailing—lies in their inadequacy in coming to grips with basic problems. Pessemer recognizes the significance of seasonal demand for many products and the influence of a store's promotional activities on its sales. But there are many other variables whose interplay is the despair of buyers. Economists have long studied the price elasticity of demand for many commodities, and even the cross elasticity of demand for one item as a function of the price of another. The concepts of substitutability and complementarity have received a great deal of professional attention. And yet much more will have to be done along such lines before the economic verities can be useful to merchandisers.

Beyond these relatively familiar principles lies a world of further uncertainty which has remained almost totally unexplored. Each of the grocery ordering systems that Pessemer recognizes relies to a great extent on historical data in one form or another, always 'supplemented by forecasts of coming events,' to use the author's phrase. Whereas Pessemer's proposed methods and his carefully worked-out manual effectively attack the problem of utilizing the historical data, they are of no help in the forecasting supplement, which may well be the truly critical part of each system. How does a store manager translate into grocery ordering four inches of snow on Friday, or a competitor's store opening in the neighborhood? How does he quantify in advance the impact on his sales of a sudden strike or layoff in a large factory whose employees are his customers?

And just how long is a season? How do the duration and intensity of the

ice-cream season compare with those of the season for corn flakes? There is perhaps no grocery item that sells at a truly uniform rate all year, regardless of other-than-seasonal factors. For this reason alone, a store manager can at best be guided only by historical data, whereas his decisions must be based ultimately on his prediction of local and temporal influences.

Added to the many variables that a manager must somehow take into account are the everyday vagaries of retail demand. Virtually any grocery buyer who has plied his trade for more than the briefest period can recount instances wherein an item that sold out rapidly when first put on the shelves, 'dropped dead' when the reorder arrived. A successful television program can change almost overnight the sales of the sponsor's product and correspondingly those of his competitors. Instant foods, diet fads, new products, new packages for old products, manufacturers' 'deals' whereby a retail price is temporarily reduced, and premium offers all take their toll of a store manager's forecasting ability.

Pessemier's monograph is a valuable contribution. The author has studied and set forth the basic elements of a part of a highly important problem. In the process of doing so he has helped to define the other—and perhaps more weighty—part. He has pointed up the challenge for other researchers, and indicated one area where a great deal more cultivation is needed before the vineyard bears fruit.

SEYMOUR T. R. ABT
Stix, Baer, & Fuller

DONALD G. MALCOLM and ALAN J. ROWE, Eds., *Management Control Systems*, John Wiley & Sons, New York, 1960, 375 pages, \$7.25

THIS volume consists of the proceedings of a symposium at the System Development Corporation, Santa Monica, California, on July 29–31, 1959. It aims to develop an appraisal of the state of the art of management controls.

What is a *management control system*? The volume suggests that management control systems are many things to many people. Perhaps the clearest definition is given belatedly on page 188: "A management control system is defined as a set of policies, procedures, and information processing which is designed to give direction to activities by clearly establishing goals, by measuring progress toward these goals, and by indicating or initiating corrective action." This definition by MALCOLM is not even listed in the Index. Other definitions are offered, e.g., "merely good management." A consensus is conspicuous by its absence.

Regarding the *present state of the art*, a suitable theory of organization control seems to be lacking. Very little attention is paid to an important segment, viz., the preparation for logic. The role of the manager in the control systems is viewed varyingly from "the weakest element" to the key figure. In this context, it is not surprising that "judgment will remain the key ingredient to executive success," according to one participant, while "the obvious effect of significant progress in this area (of cognitive machines) would, of course, be to remove the human entirely from the system," according to another. Perhaps as a result of the uncertain role of computers in management control systems, it is estimated that electronic compu-

ters are not being used "in ways that tap even one tenth of their ultimate potential in the management process—particularly in industry "

The paper, "Integrated Systems Planning at G E," by H FORD DICKIE, highlights an important experience in management control systems. Summing up the experience, Dickie says that "synergism," the sort of situation "where two things taken together have a greater total effect than the sum of the individual items alone," is the key that will open the door to industrial progress. The entire Main Line System—which converts the customer's order into a finished product—of a 'good' department was "treated as though it were a big black box with only one transaction input to this black box, the customer's order, and there was only a single basic output, the finished product. All that went on in between was subject to analysis and redesign." As a result of the work, all of the Main Line System's steps can now be performed inside the computer. "This automatically provides all the factory's action documents: purchase orders, operator instructions, quality instructions, punched paper tapes to run numerically controlled machines, customer promises, bills of material, stock order recommendations, withdrawal notices, shipping papers, etc."

In *looking to the future*, research in management control systems attempts to apply the "real time control, communication, and information system," represented by SAGE and SACCS, to business situations. ROWE points out that in order to study these problems in management controls, the programming of a general-purpose simulation model appears appropriate. According to him, existing organization structures do not [adequately?] represent the dynamic interrelation of their functions. Information flow along functional lines, leading to appropriate decision making, is crucial to a business simulation model. In evaluating the success of such simulation, other values, besides mechanistic efficiency, are involved.

Readers of this review will be interested in the role of operations research in management control systems. In the efforts to relate system requirements to control methodology, it seems inevitable that operations research can help both conceptually and technically. But any recognition of this in the volume is by default rather than by design.

There is apparently a numerical displacement in the references to the contents cited in the Preface. The Preface tells us that present practices of management control are treated in Section I, while they really appear in Section II. The Preface places the impact of computers on the design of management controls in Section II, but it is in Section III. Automated management controls are treated in Section IV, as opposed to the Preface listing of them as Section III. Future possibilities in management control and information systems is the subject of Section V in the volume, identified as Section IV in the Preface. It is unfortunate that minor, but annoying, errors of grammar and spelling are permitted to remain.

But more important is the lack of conceptual coordination, without which the book remains a collection of papers, despite the few better written papers and occasional gems of thought almost concealed between the covers.

GEORGE K. CHACKO
Hughes Aircraft Company

KENNETH E. BOULDING and ALLEN SPIVEY, *et al.*, *Linear Programming and the Theory of the Firm*, Macmillan Company, New York, 1960, 225 pages, \$8.00

THIS book is a product of a seminar for college teachers in economics, sponsored by the Ford Foundation at the University of Michigan in 1958, organized "to examine recent developments in the theory of the firm which had grown up in the last ten or fifteen years mainly in fields outside of professional economics." Among the fields listed as having been examined in pursuit of this objective are Operations Research, Management Science, Organization Theory, Cybernetics, Information Theory, the Sociology of Enterprise, and Ethical Theory of Responsible Behavior. As can be inferred from the title of the book, this part of the seminar's report is mainly concerned with the impact of the development of linear programming on the economic theory of the firm. Since perhaps no other of the techniques employed by operations researchers is more consistently associated with the field of OR by management in general, this may not seem an unreasonable choice.

A valuable historical perspective is provided by BOULDING in which he places the development of the technique of linear programming into a background of the economic problem of the theory of the firm, which he traces back at least as far as A. A. COURNOT in 1838 (*Recherches sur les Principes Mathématiques de la Théorie des Richesses*).

SPIVEY provides an elementary treatment of linear-programming concepts and the simplex method of solving systems of linear inequalities, preceded by a survey chapter of the mathematics required, apparently in an attempt to make the book mathematically self-sufficient for the reader.

Y. WU and C. KWANG contribute an expository chapter in which their goal is to phrase in the language of and at the pace of undergraduate economics students the problem of resource allocation decisions made by a firm, starting with the classical marginal-cost model, and bringing in successively complicated linear-programming-type models.

C. M. WHITE contributes an essay on the various criteria employed by the firm in making production decisions. He points out that in addition to the usual goal of profit maximization, firms are motivated by other goals as well, such as survival of the firm as a social unit, prestige (which may be compatible with the goal of maximizing long-term, rather than short-term, profits), and even the drive to achieve power.

The ORSA readership will be particularly interested in the essay by H. H. JENNEY on the nature and scope of OR. He elegantly boosts OR as follows: "OR is one of the newest tools available to those who have to organize men and resources into meaningful operating entities for the express purpose of achieving specific desired goals." He holds that (1) OR may provide a better understanding of how real-life firms operate, (2) since OR studies operations within the firm as organic units, it may provide the data and the theoretical substance for the formulation of a comprehensive theory of the large modern corporation, (3) the growth of industrial practice of OR will be reflected in changing patterns of expenditures and allocation of resources, (4) these OR influences may change the historical pattern of economic fluctuations. He further warns that

as OR contributes to and accelerates the use of automation, it may make business more efficient, but at the same time it may make the economy vulnerable to cyclical maladjustments and perhaps to social upheaval. As long as a large portion of OR models stress the minimization of costs, the increased efficiency of particular firms may well be bought at the cost of rising social costs.

Also, he argues that incentives could be put forth, through legislation, subsidization, and regulation, so that OR could be drawn toward problems of enhancing the stability of economy and encouraging further technological development, of allocating natural resources, and fostering research and data collection in an impartial and extensive manner so as to develop a science of management.

This book should be of great value to economists who are not operations researchers, but who would like to see a detailed treatment of linear programming couched in terms of an economic framework. This book should also be of great value to operations researchers who are not economists, who would like to see some of the interactions of linear programming and economic theory. All readers of this review (including economists who are operations researchers, etc.) will be well-advised to refer to this book for historical background, pedagogical material, and thought-provoking essays.

DAVID S. STOLLER
The Rand Corporation

P. ROSENSTIEHL and A. GHOUILA- HOURI, *Les Choix Economiques. Decisions Sequentielles et Simulation*, Dunod, Paris, 1960, 355 pages

THE "Economic Choices" of the title of this bilingual book are the decisions entailed in lengthy and complex processes of management, command, or design intended to yield optimal results. The eclectic list of chapters will illuminate the intent and scope.

- 1 Economic Processes and Sequential Decisions (French and English)
- 2 Programmes Dynamiques
- 3 La reproduction numérique des phénomènes aléatoires
- 4 Le traitement des modèles de simulation
- 5 Analogic Simulation of Air Traffic Control Problems—T. K. VICKERS (U.S.)
- 6 Processus d'atterrissage—P. ROSENSTIEHL
- 7 The Use of Simulation in Logistics Policy Research—W. W. HAYTHORN (U.S.)
- 8 The Simulation of a Complex River System—D. A. EMERY and B. L. MEEK (U.K.)
- 9 An Introduction to War Games—M. G. WEINER (U.S.)
- 10 Simulation pour le perfectionnement des cadres dans les problèmes de gestion—M. SIMOND
11. La simulation des phénomènes économiques où intervient la concurrence—A. KAUFMANN

The introductory chapter is repeated in English, following the French. The remainders are in the tongue of their titles, each preceded by a summary in the opposite language. The parentheses after authors' names are their nationalities.

To the subject problems are extant two approaches: theoretical calculation and simulation. The lion's share of this book concerns the latter. Chapters 2 and 6 alone are devoted to solution by mathematical analysis.

Simulation here means an operation on a complex and highly developed level, to be supervised by specialists in a technological milieu. Generally a group of humans make the decisions and electronic computers simulate the external environment, including uncertainties that are mechanized stochastically. Chapters 5, 7, 9, 10, and 11 are all reprints by authors who have played major roles in such reenactments of lengthy economic or military processes.

A main advantage of using reprints for chapters is the accumulation of diverse views. It is not attained here to the expected extent. Although each of the above five papers is individually well written, and the subjects (air traffic, parts procurement, design of a reservoir system, war and business games) are variegated, the techniques are similar and their authors are led at times to the same general observations. Whether or not the book would have been improved had this material been recast, systematized, and condensed by the main authors, we leave the reader to judge. Some concision and somewhat less redundancy would be gained, but firsthand accounts of experience would be lost. Then, too, a writer is bound to be humanly enthusiastic about his own field. Genuine cause for enthusiasm of simulation processes there certainly is, but there are also drawbacks, critiques are a perquisite of the over-all author.

More concision would also have left more space for the theoretical chapters. Chapter 2 alone is devoted to the general analysis of optimization. What is written is good, but the long list of references makes it clear that it is but a brief sample of a large field. Chapter 6 illustrates a correlation between simulation and analysis. The problem of the best height of a waiting stack of aircraft at an airport is treated mathematically, the same subject was empirically subsumed in the simulation program recounted in the previous chapter. Chapter 3 concerns techniques for obtaining various sorts of probabilistic outputs from a computer, Chapter 4 is a general sketch of the means of adapting computers to simulation programs.

This work is not a textbook, rather it is a panorama of the activities in its subject field today. The chapters on simulation do not instruct the reader in methodology, but are general descriptions with enough detail to make the scene understandable. The most elaborate exposition is Chapter 11 on business games with competition. (Section 7, incidentally, is a survey of instances to date. We recommend its prior reading as an introduction to all the chapters on simulation.) The theoretical chapters, too, are not of the ilk to supply exercise problems for the reader. At a few points, in fact, the exposition is elided enough to be obscure. In short, this is a volume for the analyst's bookcase, rather than his desk. It succeeds, and very well, in its object of presenting a broad and understandable picture of current means of scientific decision making in extensive processes. For the novice in operations research, this book is ideal, even mandatory. The initiate, too, will benefit from its unusually broad, concurrent presentation.

A few years of high school French should surmount the language difficulty with a little dictionary help, particularly as to the vernaculars in some of the specialized chapters.

RUFUS ISAACS

Institute for Defense Analyses

Books Received

- DONALD G MALCOLM AND ALAN J ROWE, Eds , *Management Control Systems*, John Wiley & Sons, New York, 1960, 375 pages, \$7 25
- RANDOLPH W CABELL AND ALMARIN PHILLIPS, *Problems in Basic Operations Research Methods for Management*, John Wiley & Sons, New York, 1961, 110 pages, \$3 95
- ROBERT B FETTER AND WINSTON C DALLECK, *Decision Models for Inventory Management*, Richard D Irwin, Homewood, Illinois, 1961, 123 pages, \$5 75
- CHARLES C HOLT, FRANCO MODIGLIANI, JOHN F MUTH, AND HERBERT A SIMON, *Planning Production, Inventories, and Work Force*, Prentice-Hall, Englewood Cliffs, N J , 1960, 419 pages, \$10 00
- KENNETH BOULDING AND ALLEN SPIVEY, *Linear Programming and the Theory of the Firm*, The Macmillan Company, New York, 1960, 225 pages, \$8 00
- C WEST CHURCHMAN, *Prediction and Optimal Decision*, Prentice-Hall, Englewood Cliffs, N J , 1961, 394 pages, \$9 00
- RICHARD BELLMAN, *Adaptive Control Processes, A Guided Tour*, Princeton University Press, Princeton, N J 1961, 255 pages, \$6 50
- HERMAN KAHN, *On Thermonuclear War*, Princeton University Press, Princeton, N J , 1960, 651 pages, \$10 00
- M G BEKKER, *Off-the-Road Locomotion, Research and Development Terramechanics*, The University of Michigan Press, Ann Arbor, Michigan, 1960, 220 pages, \$10 00
- ROBERT SCHLAIFER, *Probability and Statistics for Business Decisions*, McGraw-Hill Book Company, New York, 1959, 732 pages, \$11 50
- R W MORRELL, *Managerial Decision-Making*, Bruce Publishing Company, Milwaukee, Wisc , 1960, 201 pages, \$6 00
- LAJOS TAKÁCS, *Stochastic Processes*, John Wiley & Sons, New York, 1960, 137 pages, \$2 75
- MIHAJLO D MESAROVIĆ, *The Control of Multivariable Systems*, The Technology Press and John Wiley & Sons, New York, 1960, 108 pages, \$3 50
- ELIE J BAGHDADY, *Lectures on Communication System Theory*, McGraw-Hill Book Company, New York, 1961, 617 pages, \$12 50
- V I TATARSKI (Translated by R A SILVERMAN), *Wave Propagation in a Turbulent Medium*, McGraw-Hill Book Company, New York, 1961, 285 pages, \$9 75
- JOHN VON NEUMANN, *Continuous Geometry*, Princeton University Press, Princeton, N J , 1960, 299 pages, \$7 50
- WILBUR R LEPAGE, *Complex Variables and the Laplace Transform for Engineers*, McGraw-Hill Book Company, New York, 1961, 475 pages, \$12 50
- LEONARD DE VRIES, *The Book of the Atom*, Macmillan Company, New York, 1960, 267 pages, \$3 95
- JAMES E DRUMMOND, *Plasma Physics*, McGraw-Hill Book Company , New York, 1961, 386 pages, \$12 50

Comments

BEKKER's *Off-the-Road Locomotion* follows his *Theory of Land Locomotion* and seeks to fill the theoretical vacuum facing the designer of cross-country vehicles

SCHLAIFER's *Probability and Statistics* is subtitled "An Introduction to Managerial Economics Under Uncertainty " It is a 'nonmathematical' introduction to the subject according to the preface but is replete with arithmetic and considerable

notation After an introductory section, use of probabilities, random processes, sampling, the value of additional information, and objectivist statistics are considered

AT THIS late date, more than twenty years after the emergence of operations research as an aid to decision-making, it is hard to believe that a book on *Managerial Decision-Making* can appear, complete with references to operations research, that displays such profound nonunderstanding of what we have been trying to do for these many years But such is the case with MORELL's slender volume The author dismisses us very quickly and then goes on his merry way—but without this reader!

TAKÁCS' *Stochastic Processes* is in the Methuen Monographs on Applied Probability and Statistics It considers Markov chains, Markov processes, non-Markovian processes, and the solution of problems in these three areas

MESAROVIC'S *Control of Multivariable Systems* is the latest in the Technology Press Research Monographs Its thesis is that the "cybernetical approach causes discrepancies at the engineering level that can be reduced only by theory based on true multivariable models and not on single-variable abstractions"

Lectures on Communication System Theory is the "outgrowth of a set of notes for a special summer program on 'Reliable Long-Range Radio Communication'"

TATARSKI'S *Wave Propagation in a Turbulent Medium* is another in the growing list of translations of Russian monographs It is a companion to CHERNOV'S *Wave Propagation in a Random Medium* The book is photo-offset from elite typewriter copy

VON NEUMANN'S *Continuous Geometry* has been put into book form by ISRAEL HALPERIN The original multigraphed version was based on lectures given at Princeton in 1935–1937

PERIODICALS

Selected Contents

Operational Research Quarterly, December 1960

- J LESOURNE, *The Place of Operational Research in the Development of Modern Society*
- P I WELDING AND J STRINGER, *A Problem in Vehicle Fuel Consumption*
- B BENJAMIN, W P JOLLY AND J MAITLAND, *Operational Research and Advertising Theories of Response*
- B D HANKIN, *Operations Room Technique in Operational Research*
- P M BLUCK, P G SMITH, AND G THACKRAY, *Production Planning and Inventory Control on a Chemical Plant*
- R C COOKE AND D ROBINSON, *Automatic Data Collection and Analysis for Works Investigations Early Experience with an Automatic Performance Recorder*

Management Science, October 1960

- HENRI THEIL AND C VAN DE PANNE, *Quadratic Programming as an Extension of Classical Quadratic Maximization*
 FRED M TONGE, *Summary of a Heuristic Line Balancing Procedure*
 PETER WEGNER, *A Non-Linear Extension of the Simplex Method*
 SAMUEL EILON, *A Note on the Optimal Range*
 H EMANUEL, L H KLAASSEN, AND HENRI THEIL, *On the Interaction of Purchasing Motives and the Optimal Programming of Their Activation*
 E P ADLER, *Relationships Between Organization Size and Efficiency*

Management Science, January 1961

- C B MCGUIRE, *Some Team Models of a Sales Organization*
 KALMAN J COHEN AND ERIC RHENMAN, *The Role of Management Games in Education and Research*
 D R FULKERSON, *A Network Flow Computation for Project Cost Curves*
 G HADLEY AND T M WHITIN, *An Optimal Final Inventory Model*
 GEORGE W WILSON, *A Note on Accelerated Dollar Averaging*

Journal of Industrial Engineering, November-December 1960

- T T KWO, *A Method for Designing Irreversible Overhead Loop Conveyors*
 M E BRONSON, *Program Loading*
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 RALPH F HUTH, *Factorial Chi-Square as a Search Technique*
 ARJAN BHATIA AND ANAND GARG, *Application of Dynamic Programming to a Class of Problems in Inventory Control*

IRE Transactions on Engineering Management, September 1960

- H W MARTIN AND R J THOMSON, *Work Measurement and Productivity in Engineering Design*
 R W HAINE AND W LOB, *The Application of Closed-Loop Techniques to Engineering Project*
 RAOUL J FREEMAN, *A Generalized Network Approach to Project Activity Sequencing*
 OFFICE OF SPECIAL STUDIES, NATIONAL SCIENCE FOUNDATION, *Funds for Research and Development Performance in American Industry, 1958 A Preliminary Report*
 EUGENE WALTON, *What is the Role of the Government Laboratory?—A Questionnaire Study in One Government Laboratory*
 D R J WHITE AND T J HICKEY, *A Model for Planning Study-Type Contracts*

Recherche Opérationnelle, Volume 4, Number 4

- E VENTURA, *Comment Apprendre la Recherche Opérationnelle? Homage à Georges Darmois*
 J AGARD, *Problèmes d'Attente dans une Compagnie Aérienne*
 C CHANDESSAIS, *Usage des Variables Psychologiques en Recherche Opérationnelle*

And Some Notes

MIT's project on Fundamental Investigations in Methods of Operations Research has published Interim Technical Report No 16, "Depot System Simulation I"

It was constructed for an IBM 704 and "operates a geographic complex of co-operating depots stocking a given item of supply for a captive demand "

The Engineering Journal (of Canada) for November 1960 has an article on "An Exercise in Operations Research RCAF Aircraft Maintenance," by A B HOWELL. It is the result of an effort to "derive more exact expressions for aircraft group response to use and change, and by relating these expressions to work equations, develop deterministic analyses for the better guidance of maintenance and flying management "

SEYMOUR DFITCHMAN AND ALFRED BLUMSTEIN analyze major considerations involved in "Air Traffic Control" in the December 1960 issue of *Scientific American*

THE OCTOBER 1960 issue of the *SIAM Review* has two articles of interest to operations-research workers BEN BERNHOLTZ writes on "Optimum Allocation of Discharge to Units in a Hydroelectric Generating Station," and E S WOLK has an article on "Torpedo Hit Probabilities "

THE DECEMBER 1960 issue of the *Journal of the American Statistical Association* has several articles of possible interest to operations-research workers RALPH L NELSON writes on "Market Growth, Company Diversification and Product Concentration", H LEON HARTER and P B MORANDA each have an article on circular error probabilities, and MARTIN SHUBIK provides a "Bibliography on Simulation, Gaming, Artificial Intelligence and Allied Topics "

Aerospace Engineering for January 1961 has an introductory article on "Analysis of Weapon Systems Effectiveness" by JOHN G BARMBY

ROBERT B GRANT provides a simplified explanation of the use of linear programming in "Mathematically Influenced Decision-Making" in the January 1961 issue of *N A A* (National Association of Accountants) *Bulletin*

RONALD W SHEPHARD describes a dynamic-programming approach to "Least Cost Scheduling of Daily Local Deliveries" in *The Production Engineer* for November 1960

RAOUL FREEMAN's "Marginal Sampling and Primary Trade Areas" appeared in the August 1960 issue of the *Savings and Loan Journal*. It discusses the application of quantitative techniques to bank location problems

IN A SURVEY article in *MTW* (*Mathematik, Technik, Wirtschaft*) Vol 7, No 4 (1960), GNEDENKO reports about the development and significant generalizations of queuing theory in Soviet Russia KNODEL discusses the application of a mathematical network model to traffic planning in Vienna HELLMICH claims a new method for approximate solution of the traveling-salesman problem (Submitted by FRED HANSSMANN)

JAMES R. JACKSON's paper given at the 1960 TIMS meeting has been published as Management Sciences Research Project (UCLA) Discussion Paper No. 76. Its title is "On the Theory of Queues with Dynamic Priorities." The Project's Research Report No. 68, "A Note on Pyramid-Building," by ZIVIA S. WURTELE, has also been published. It discusses "the effect on the rate of balanced growth of adding to a closed Leontief-type economy industries whose outputs are used neither directly nor indirectly for the production of consumption goods."

WILLIAM J. PLATT has produced a Stanford Research Institute Staff Paper, "Toward Strategies of Education." In it he urges studies of an operations-research or economic-analysis nature to design educational programs for all, but particularly underdeveloped countries, taking into account specific needs and the resources of the countries involved. He makes the excellent point that investment in education should be evaluated much as investment in research and development or capital goods is evaluated in order to develop optimal strategies of resource allocation among activities most fruitful in advancing a nation. It is a thoughtful and thought-provoking analysis.

THE *Journal* of the Stanford Research Institute for the Fourth quarter of 1960 is devoted to "The City in Transition" and contains five articles providing excellent conceptual material for operations-research workers interested in city planning and related fields.

THE NOVEMBER-DECEMBER 1960 issue of *Harvard Business Review* has an unusual number of articles of interest to operations-research workers and even more for those interested in corporate planning. HARVEY N. SHYCON and RICHARD B. MAFFEI write on "Simulation—Tool for Better Distribution." MELVIN ANSHEN has an article on "The Manager and the Black Box" in which he takes a more encouraging than usual view, for middle management, of the impact of information technology. JAMES R. BRIGHT asks "Are We Falling Behind in Mechanization?" WARREN H. SCHMIDT and ROBERT TANNENBAUM address themselves to the "Management of Differences." And ROBERT N. ANTHONY outlines "The Trouble with Profit Maximization." In the following issue (January–February 1961), JAMES C. HETRICK describes a new approach to planning and budgeting. The basic technique is the transportation model.

R. HUNT BROWN writes on "Operations Research" in *Management and Business Automation* for August 1960. This reviewer could not finish the article after he learned that British and American scientists made studies of "military logistics" (such as optimum height for a bombing run) and that "the applications of OR by companies on their own computers are legion." He hopes that very few management people prove so naive as to accept this article as a description of operations research. He would like to reiterate his unhappiness at the obscuration of the conceptual base of operations research by those who insist upon equating operations research with mathematics, computing, etc.

THE FEBRUARY 1961 issue of *Management and Business Automation* continues its

'hard sell' of operations research "Operations Research—Management's Crystal Ball" is the title and second of the 'pitches' in the 'hard sell' The first is a summary at the top of the page characterizing operations research as "a boon to the businessman who can't afford to be wrong" (We won't count the tabloid approach of the headline on the front cover) On the basis of some experience, your editor can say that such overenthusiasm takes a long time to clear away in any organization infected by it—before useful and constructive operations research, at the mundane and incremental level at which it is practiced, can succeed

THE NOVEMBER 12, 1960, issue of *Business Week* has an article on the growth of C-E-I-R under the heading "How a New Industry Grows Up"

THESES

A Theory of Adjusting Parameter-Estimates in Decision Models,
SHIV K. GUPTA, Ph D in Operations Research, Case Institute
of Technology, June 1960, Case Institute Library (Loan)

EXACT values of parameters appearing in decision-making models are seldom, if ever, known and must be estimated whenever a given decision function is to be used Traditional statistical techniques of estimation generally fail to take into account consequences of the effect of overestimation and underestimation of the parameters Consequently, it is desirable to establish procedures for using estimates in such a way that the 'cost of error' resulting from their use is reduced Pragmatically, then, it is important to find a procedure that will minimize the expected cost of error and/or its variance

The nature of a general solution to this problem is discussed, and a specific method of *adjusting* parameter estimates is developed In particular, techniques are given for models involving one parameter, and suggestions are given for extending these techniques to the cases of two or more parameters In essence, the procedures developed call for adjusting (biasing) estimates in such a way as to take into account the asymmetry of the 'cost of error' function, and accomplish the desired reductions

Calculation procedures are given, and examples are presented that illustrate the usefulness of taking consequences into account when estimates of parameters are used in decision models

International Trade Aspects of Indian Burlap—An Econometric Study,
GEORGE K. CHACKO, Ph.D in Econometrics, Graduate Faculty
organized under The New School for Social Research,
New York, November 1959, 228 pages, Bookman
Associates, New York, \$10 00

HERE THE theory of games has been explored with reference to international trade In an examination of the Indian jute industry, involving the United States, the United Kingdom, India, Pakistan, and Japan as 'players,' the author

shows how both India and Pakistan can *double* their individual 1957 earnings by means of one coalition following a policy of gross revenue maximization

This volume answers such questions as "How can India improve her earnings from jute exports to the United States?" "How does burlap stand in the competition against paper, cloth, and other substitutes?" "How much will the market pay for a ton of burlap, and how much will it buy?"

Demand equations and a study of the price elasticity and crosselasticities of demand, provide the setting for the game analysis. In addition, relevant non-economic factors, such as the role of Communist China and the experiments in economic democracy made by India and Japan, are discussed. The threat analysis includes the alternative cost of growing jute to India, and the manufacture of jute to Pakistan. The side payment corresponding to the coalition earnings is discussed in the light of the most reasonable earnings expectation of the individual members of the coalition. The coalition earnings assume fresh significance when compared with the possibility of nonsurvival in the absence of such a coalition, India and Pakistan each seeking to flood the United States market with an individual supply of jute manufactures as an alternative to coalition.

***On Research and Development Budgeting and Project Selection,*
SIDNEY W. HESS, Case Institute of Technology, 1960, Case
Institute Library (Loan) and University Microfilms, Inc.**

C ONTEMPORARY models of research and development are incomplete in that they ignore the many reappraisals and budgeting decisions that occur in the time between a project's proposal and its commercialization. The sequential decision aspects of project budgeting are particularly important since (a) the research expenditure is usually an order of magnitude less than the irrevocable investment for commercialization and (b) an allocation to a project today does not presuppose continuation of the project into future periods.

After examining the merits and deficiencies of conventional allocation models, the budgeting problem is restructured to take into account the sequential decision characteristic. Utilizing the technique of dynamic programming, methods are developed to determine optimal project budgets when the aggregate research and development budget is either constrained or unconstrained. These models also suggest a rational explanation of the patterns of project expenditures over time that one observes in practice.

Finally, the research process is shown to be analogous to a queuing process. As such, the techniques of queuing theory may be efficiently utilized for budgeting and project selection where (a) a large number of similar projects are worked and (b) their success is reasonably certain.