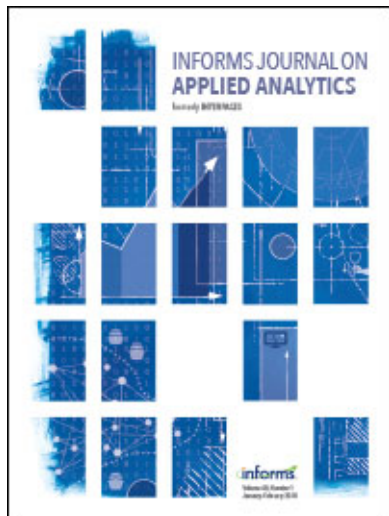




Interfaces

Publication details, including instructions for authors and subscription information:
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To cite this article:

(1978) Book Reviews. Interfaces 8(2):106-117. <https://doi.org/10.1287/inte.8.2.106>

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Book Reviews

MICHAEL E. THOMAS

ACKOFF, RUSSELL L. et al., *Designing a National Scientific and Technological Communication System; The SCATT Report*, University of Pennsylvania Press, 1976, 173 pp., \$12.00.

In "Redesigning the Future,"* Russell Ackoff advocated the use of idealized design as a basis for practical planning. In "The SCATT Report", Ackoff and coworkers convert theory to practice by presenting their idealized design for a system of scientific communications and technology transfer. The book is essentially the final report on a multi-year Phase I NSF grant.

Idealized system design, as defined by Ackoff, requires only that proposed technology be known to be feasible and that the proposed system would be capable of operating if it were implemented. Among the advantages claimed for idealization are that it removes dependence on the past, that it promotes participation by the stakeholders in the design process, and that it focuses on the system rather than its components. The authors insist, and rightly so, that the purpose of the present work is not to design a specific alternative to the present system, but to provide a basis for moving forward from the present system. They miss a fundamental point, however. The authors plunge ahead into an idealized system design without asking whether such a system is really required. They assume the need for the system as given. There is an analogy in transportation where many are coming to the view that, rather than trying to provide an ever more complex transportation system, it may be wiser to find substitutes such as communications to satisfy demand.

The basic concept proposed involves extensive use of computer and communications technology to provide an integrated national system. The report calls for a national SCATT center supported by 10 to 15 regional centers and 100 to 150 local

* Reviewed in November 1977 *Interfaces* (Vol. 8, No. 1, Part 1).

centers. These centers would act as clearinghouses for documents, data, meetings, and technology exhibits. They would also act as coordinators for evaluating the quality of the information being disseminated. The measures of quality proposed are based on the frequency of use and the automated feedback of reader opinion. These factors would be used to establish hierarchical ratings. Documents that are little called for or are poorly received would be placed deeper in the archives, while best sellers would rise to the top. Such a system is basically cooperative. Its effectiveness depends heavily on the good will of its users. It could also become subject to gaming and manipulation, although this aspect is neglected.

One proposed concept perturbed me. SCATT calls for the funding by NSF of Fellows, technical experts to be named by the professional societies and NSF. These Fellows would, assumedly, be scientists of top caliber, who would be available as consultants on the literature and who would prepare annual reviews of advances intended for people inside and outside their field. Although such services could be invaluable, the concept raises significant career problems for the individuals involved who would have to take one or more years out of their productive lifespan with attendant start-up and restart costs to them.

The proposed design places new restrictions and requirements on existing institutions. For example, journals would be required to publish abstracts from independent outside readers, societies would be required to publish monthly periodicals that contain descriptions, in 500 words or less, of recent results, and societies would have to unbundle dues and subscription costs. Although the various proposals can be defended individually as overcoming deficiencies in present practice, when taken together they result in a system that is not only highly centralized, but appears quite authoritarian. The authors may be repeating the cycle that has been observed in information processing. We now realize that a large mainframe computer that integrates all the requirements of a complex organization may be enormously inefficient compared to a distributed system whose individual elements are highly tailored to the information demands of their small communities of users.

Chapters of the book deal with the design, operation, technology, and economics of the system. The level of detail is uneven. Some parts, such as those dealing with organization or the use of similarity indexes, are quite specific on how the system works. Others, particularly the chapter on economics, enunciate policy without presenting the necessary backup to establish feasibility. A useful feature of the book is a chapter describing the present system of scientific communication that puts both the problem and the proffered solution in perspective.

In judging this work, it is important to keep in mind the nature of idealized design. It is easy to quibble about specific features or details and even to reject the overall result. The contribution of the book is that it is a case example of what skilled practitioners can do by using idealized design to structure a new system design that is not the victim of past history.

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BEENHAKLER, H. L., *Handbook for the Analysis of Capital Investments*, Greenwood Press, 1976, 452 pp.

The title of this book suggests that it is a handbook and in the preface the author suggests that it is suitable for use as a textbook. Unfortunately, neither is the case. As a handbook it suffers from lack of completeness and conciseness, while as a text it suffers from lack of consistency in the level of presentation and a complete lack of problems.

The book begins with a review of basic interest calculations and a discussion on the determination of the cost of capital in the private and public sectors. It then proceeds to the analysis and selection of investment projects at the firm level. This is followed by an overview of economic planning considerations for a country. The book then proceeds back to micro level analysis with a chapter on leasing, replacement, and expansion investments and ends with a chapter on diversification planning for a firm.

With the exception of the placement of a section on risk and uncertainty after the section on cost of capital and the inclusion of the section on economic development planning, the material does follow in a logical sequence. The material on risk and uncertainty deals with project selection rather than interest rate determination and it should have been integrated into a similar section in the chapter on project appraisal. Fifteen pages are devoted to a review of economic development planning for a country. The treatment is superficial at best and one wonders why it was included at all.

Throughout the text there is a wide disparity in the level of presentation. For example, the chapter on project appraisal is at a very elementary level and the reader is advised that various relationships between project selection rules can be derived mathematically. The next chapter, however, includes not only a rudimentary presentation of the assignment, transportation, and simplex algorithms, but also an in-depth presentation of an heuristic algorithm for solving a capital budgeting problem.

On the plus side, the discussion on cost of capital is more extensive than normally found in a text and the chapter on programming and planning includes an interesting formulation of a capital budgeting problem in the format of a transportation problem. There are also extensive appendices dealing with such topics as the application of Z-transforms in the analysis of cash flows, a brief review of accounting principles and financial ratios; and autocorrelated cash flows.

Overall, however, the book suffers from lack of a clear purpose and from an uneven level of presentation. It offers little that is not already available in other texts in this area.

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BEILBY, M. H., *Economics and Operational Research*, Academic Press, 1974, 174 pp., \$12.00.

Beginning with the theories of consumer behavior and firms in their classical optimization structure, Beilby makes a smooth translation of these concepts into the more operational form of linear programming, then covers their application to several fundamental problems in urban and regional planning. There is little original material in this book. The principles are those well-established in microeconomics and mathematical programming; the applications to transportation planning, locational behavior, input-output analysis, and interregional linear programming are taken from well-known references (e.g. Hitchcock, Charnes and Cooper, Herbert and Stevens, et al.) The contributions of this work are the compilation of several linear models that are basic to urban and regional planning and the formal relationship of these models to microeconomic theory.

Except for the applications, contents of the book parallels earlier texts by Dorfman, Samuelson, and Salow, *Linear Programming and Economic Analysis* and Baumol, *Economic Theory and Operations Analysis*. However, Beilby's style is more formal and concise than those earlier texts. Students with a good comprehension of basic differential and integral calculus will find it straightforward, well written, easy reading; those who like their mathematics sprinkled with an abundance of numerical examples and graphic illustrations will find easier going in the previously mentioned texts.

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BERTSEKAS, DIMITRI P., *Dynamic Programming and Stochastic Control*, Academic Press, 1976, 397 pp., \$22.50.

This book presents a well-balanced survey of discrete-time stochastic dynamic programming. Although it is about the control of stochastic systems, it contains almost no material on stochastic processes in the usual probability theory sense. For this reason, many of the results presented are rigorously justified only in the case of finite-horizon problems involving discrete (countable) random variables. However, in "Notes" at chapter endings, references are given to more general treatments of the topics covered in the book. By restricting the domain of application in this way, the author is able to treat a broad range of topics in a readable form. The basic ideas and techniques of stochastic dynamic programming are thereby covered in a manner suitable for classroom use, but without the necessity of ploughing through the sigma-fields, Martingale convergence theorems and nonanticipative stopping times, which are characteristic of much of the literature of the subject. This is precisely what the author wanted to accomplish, and I believe he has succeeded.

The first chapter is an introduction to problems of decision-making under uncertainty. It includes a straightforward version of axiomatic expected-utility theory, with the intent presumably being to justify the almost exclusive concentration on ex-

pected value functions throughout the remainder of the book. This is followed by a simple treatment of some nonsequential decision problems: the minimization of expected quadratic cost, the one-period inventory problem with fixed costs, and single-period portfolio analysis. Next, there is a section on sequential decision-making. Here, the author immediately gives an "abstract" version of the problem, using the formal language, notation, and style of later chapters. Although the presentation is not difficult to follow, it is devoid of motivating concepts. Perhaps a more elementary presentation with a liberal dose of simple examples would have been preferable in an introductory chapter.

Part I, beginning with Chapter 2, concerns the control of uncertain systems over a finite horizon. Chapter 2 itself presents the dynamic-programming approach to sequential decision-making. It treats only the problem of additive cost functions with general single-period components. After developing the basic dynamic-programming functional equation for the case of intertemporally independent random disturbances, it shows how to embed more general problems, involving forecasts and correlated disturbances, within the general framework of the chapter. Later chapters cover applications in specific areas (linear-quadratic systems, inventory control, dynamic portfolio problems, stopping problems), problems of imperfect state information (including the separation property for linear-quadratic systems, and the Kalman filter), and computational considerations. The chapter on computational aspects contains a readable account of various suboptimal controls, including open-loop-control, open-loop-feedback control, and hybrid generalizations. Since the discussion is held to a general level, the chapter has little specific information helpful to someone facing an actual, dimensionally-cursed D.P. problem.

Part II, beginning with Chapter 6, concerns infinite horizon problems. The chapter on minimization of discounted expected cost is well written. It contains some interesting generalizations of McQueen's bounds in value-oriented iterative procedures of the Gauss-Seidel type. On the other hand, important practical considerations regarding the ordering of the state space, suboptimality tests, and various over-relaxation techniques, have not been covered. The chapter also contains material on problems with unbounded costs per stage, and problems having nonstationary or periodic dynamics. The remaining chapters cover undiscounted total cost problems (positive and negative dynamic programming, optimal stopping, first-passage problems), and average-cost problems. Many of the example applications from Part I are redone in an infinite horizon setting, either as illustrations of the theory, or for their own intrinsic worth. The general tone of Part II is more highbrow than that of Part I. It is concerned in large measure with questions of existence, uniqueness, convergence, and so forth. Even so, the treatment is actually quite straightforward. My main complaint is that the notation tends to be unnecessarily general in comparison with the actual depth of coverage.

There are numerous problems at the end of each chapter. They are mostly theoretical in nature, although a few problems with a computational orientation occur. Many of the problems, especially in the second half of the book, deal with extensions of the results and techniques in the text. There do not seem to be any impossibly difficult ones, but some of them are quite challenging.

The book would be suitable for a graduate-level course in dynamic programming in an Engineering, Operations Research, or Applied Mathematics department. Students would find it troublesome, but not impossible to read. It provides a number of examples and problems useful to an instructor and, suitably augmented, would form a good basic textbook in the subject. I would not want to try using it with students having no prior exposure to dynamic programming, but the amount found in most introductory O. R. textbooks would be adequate background preparation. Finally, it is a book that most academic O. R. workers would find useful. Its nearest competitors are Ross' *Applied Probability Models with Optimization Applications* (Holden-Day, 1970) and Kushner's *Introduction to Stochastic Control* (Holt, Rinehart and Winston, 1971). It works at a lower mathematical level than either of these, and in addition treats only discrete-time problems. Nevertheless, it is a fine book at its intended level, and may well become a standard source in years to come.

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CLARK, COLIN W., *Mathematical Bioeconomics: The Optimal Management of Renewable Resources*, Wiley Interscience, Pure and Applied Mathematics Series, New York, 1976, 352 pp., \$21.95.

Professor Clark's addition to the literature of optimal management of renewable resources is a welcome first step in documenting the recent results in this field. During the past decade a diversification of Applied Mathematics and Operations Research in areas of application has taken place. One such area is that of renewable biological resources. Optimal strategies for managing fisheries, forests, agricultural crops, etc., are studied using a variety of mathematical models and constrained optimization techniques. Dr. Clark has written a lucid text, with a relaxed open style that well organizes and communicates the various models, techniques, and results.

The book is limited to a study of deterministic models both in continuous and to a lesser extent discrete time. The particular area in optimal control theory that is used throughout the book is the maximum principle and calculus of variation. The book is analytical in its approach, with classical population models (particularly fisheries) presented as illustrations of the results of optimal control. The typical problem is one of finding a trajectory function of time (representing harvesting) which maximizes an integral (representing profit) subject to differential equations.

The author's objectives are well stated. To him, resource conservation is not preservation of natural environment but rather optimal use of natural resources over time. Conservation theory is based on explicit dynamic mathematical models of biological processes and of the economic system.

Careful distinction is made between the objectives of society vs. private resource exploiters both with "open access" and with "private ownership" resources. The impact on the industry and harvesting policy of the discount rate, of taxation or subsidy, and of nonlinear supply and demand models are also discussed.

The author has successfully demonstrated that a dynamic theory of renewable

resource management exists and that the mathematical calculations are not as complex as commonly supposed. Purposefully excluded from this work are stochastic aspects, effect of uncertain or incomplete information, computational procedures such as simulation, and the significant statistical problems with data in this field. Each of these topics is deserving of a book in renewable resource management on its own.

The book is somewhat too theoretical from an ecologist's point of view. Not enough tools are provided to this audience within the book itself to enable them to get a handle on solving problems. To shift the balance from the theoretical approaches toward applications of these models, more computational methods and examples would be needed. From the theoretical point of view, the mathematics is standard for applied mathematicians and control theory experts. Thus depending on the audience, the mathematics (particularly of the maximum principle) may be either too much or too little. For economists with mathematical backgrounds studying renewable resource economics, the book would be well balanced in this regard.

Personally, I would like to see the short and excellent policy implications expanded. The contrast between societal objectives vs. private objective, alternative regulatory strategies, the implications of using incorrect management criteria such as the maximum sustainable yield, and the implications of various discount rates are all discussed too briefly.

The book, on balance, will be a required valuable addition to the bookshelf of those in this field.

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COOPER, CARY L., ed., *Developing Social Skills in Managers: Advances in Group Training*, New York, NY, Halsted Press, 1976, 165 pp., \$15.95.

Cooper's *Developing Social Skills in Managers* is a fine collection of readings on the subject of group training and human relations technologies and theory, but does not focus, as the title may suggest, upon the development of managerial goodness through human relations and group training. That simple fact, however, should not prevent you from reading the book, for Cooper has quite adequately covered the subject of group training in general without overwhelming you in either length or jargon. The book is especially recommended for people whose knowledge of group training theory and technology extends little beyond that of Bob, Carol, Ted and Alice.

To Cooper's credit, group training is not presented as the total panacea that the consciousness of people of the late 60's would still want us to believe, i.e., group training techniques can be dangerous to some people's mental health and that consequently some kind of guideline should be used in the selection of trainees and trainers in group development to minimize the possibility of psychological disturbance. There is also some discussion of dysfunctions created from applying what has been learned through individual "stranger" encounters in an unchanged occupational organization upon completion of training—a real and present danger in group training programs. More time should have been spent on the discussion of the potential evils of group

training technology may make it possible for certain individuals to manipulate or control subordinates and fellow employees.

The series of 13 edited papers is divided into four parts. Part I deals with the history and evolution of group training methods and some recent developments such as that of group trainers having to deal with the current interest by participants to learn about the self rather than more traditional group dynamics topics such as leadership and intergroup properties. Part II concentrates on the mechanics of making an effective group. This section covers quite adequately the subjects of formation of group leader teams, structures of group exercises and research on the learning mechanisms of group experiences. Part III discusses the design of group training programs in the context of developing programs which can achieve managerial and organizational objectives, whatever they may be, through group training. And finally, Part IV describes application of group techniques in organizational settings. More space should have been allotted to this topic, perhaps half of the book. Mangham's paper on team development in industry is particularly well done.

A statement on the future use of group training methods at the conclusion of the book was rather interesting. Cooper briefly proposes that as economic conditions continue to worsen at the turn of the century and working classes come to realize that a higher standard of living will not be available, group training should be used in community development to help cope with the tensions created by limited resources and educational development to help cope with the tensions created by limited resources and educational opportunities. Cooper doesn't say whether the primary objective is to make people happy with their lot or to develop collective ways of improving their lot. I prefer to assume the latter because of my own efforts to use group training techniques which have met with some success with subsistence farmers in developing countries as a vehicle for technology transfer and an improved quality of life.

Unfortunately, returning to industrial uses of group training, as much as there is a need for implementation of human relations and group training methods to promote industrial democracy, Kelly may be closer to present day realities in his analysis that human relations and group training procedures fail in industry not because they aren't needed, but because the *economic* mandates of an organization preclude administrative support of good human relations in times of trial, i.e., when recession economies come into play. Consequently, I'm rather pessimistic about developing long-term social skills in managers in the majority of American industry under present economic and organizational realities, and in fact fear that the birth of a real theory *X* managerial philosophy and unsocial skills based on oppression due to scarcity, may be our more immediate organizational inheritance.

Allen D. Jedlicka

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LEIBENSTEIN, HARVEY, *Beyond Economic Man*, Cambridge, Mass., Harvard University Press, 1976, 287 pp., \$15.00.

In 1966 Harvey Leibenstein introduced the provocative hypothesis that allocative inefficiency is significantly less serious than what he has labelled X-inefficiency

which results, for example, from the failure of a firm to operate on the frontier of its production possibility set. In conventional microeconomics, no firm would permit such an inefficiency to exist so as Leibenstein indicates, "What is needed is a theory as to why X-inefficiency should ever exist in the first place, and one that suggests or enables us to analyze the circumstances under which greater or lesser degrees of X-inefficiency is likely to exist" (p. 9). *Beyond Economic Man* presents the needed theory. The book is divided into three parts with the first part dealing with the issue of X-inefficiency itself and the philosophical foundations on which the book is based. Part 2 deals with psychological postulates that form the basis for the microtheory of X-inefficiency, while Part 3 deals with the implications of the theory for economics and for the management of organizations. The book is nontechnical and is written so that the theory is accessible to readers with diverse disciplinary backgrounds.

In contrast to conventional microeconomics, Leibenstein does not consider households and firms as the basic units of analysis but instead focuses on the individuals who comprise those units. A central feature of his microtheory is the concept of the effort decision of an individual. An individual's employment contract with a firm is viewed as being incompletely specified permitting the individual to interpret his position and to determine the activities, pace, quality and time pattern that characterize his effort. An individual's choice of an effort point depends on his psychological characteristics and on the incentives, motivation, and atmosphere provided by the firm. An individual chooses an effort point in an "inert area" that Leibenstein describes as a "set of effort points whose associated levels of utility are not equal, but in which the action required to go from a lower to a higher utility level involves a utility cost that is not compensated for by the gain in utility" (pp. 111–112).

In firms, individuals are combined into groups, and the interdependencies among individuals in a group and among groups cause an individual's inert area, and hence his choice of an effort point, to depend on the choices made by other individuals. Because of these interdependencies, Leibenstein concludes that, "the process of selective rationality allows for the choice of decision procedures at lower effort levels than the levels implied by maximization or optimization . . ." (p. 134). The firm and its managers struggle against this "effort entropy" and the resulting X-inefficiency using "intent and motivational signals" and the incentive-reward system of the firm. There are three particular properties of the resulting internal equilibrium of the firm that differ from those of conventional microeconomics: "cost per unit of output is not minimized by the firm; profits are not maximized; and observable opportunities for gain may not be pursued or avoidable situations which involve losses may not be avoided" (p. 177).

Individuals also interact within households, and an analysis similar to that for the firm leads Leibenstein to conclude that "the demand function would be represented graphically, not by a curve, but by a band which captures the notion of inert areas for household members" (p. 196). An equilibrium in a market thus involves "a determinate area which represents those prices (for the quantity involved) which are simultaneously acceptable to both buyers and sellers, that is, which are simultaneously in the inert areas of both groups" (p. 217).

While Leibenstein's theory provides a more detailed description of the internal activity of firms and households, the components of his theory are not easily measured making prediction difficult. Such a theory is consistent with Leibenstein's methodological viewpoint that "the purpose of scientific theories is to obtain coherent explanations of phenomena and events." For those readers who judge a theory for its predictive power, the question that will remain is not whether the theory describes the behavior of economic agents in a more detailed manner than does conventional economic theory, but instead whether the theory is useful in predicting the likely outcome of economic activity. In the third part of the book, Leibenstein does consider applications, but those applications tend to illustrate the explanatory not the predictive power of the theory.

Theories may also be judged on the basis of their diagnostic and prescriptive powers. With respect to its diagnostic power, Leibenstein states that a manager who analyzes this organization in light of the theory "would learn a great deal about his firm." In the prescriptive sense of indicating how X-inefficiency can be reduced, Leibenstein, however, can only suggest that "such an exercise would by itself suggest or reveal a number of possibilities for improvement."

Many readers, particularly those who are comfortable with conventional microeconomic theory, will be tempted to translate Leibenstein's theory into the customary economic terminology and to apply the usual optimizing methodology. One view of Leibenstein's theory is that it provides insights into the factors that ought to be included in conventional theory for those who wish to stick with that theory. For example the idea of an inert area, defined above, might be reformulated in terms of conventional theory by incorporating "adjustment costs" or by postulating a utility function that depends on more arguments than those that Leibenstein ascribes to an individual's preferences. The "utility cost" mentioned in the above quotation regarding an inert area is such an example. If an individual's utility function were reformulated to reflect, for example, "disapproval from some individuals" (p. 112) resulting from a change in an effort point, the observed effort point might be optimal in this larger sense. Leibenstein would likely retort that this line of argument is part of the "prospective belt" of existing theory that "allows for a range of reinterpretation in the face of criticism so that the criticism is disarmed . . ." (p. 27).

The motivation for Leibenstein's new microeconomics is his observation of the existence of X-inefficiency, but some readers will feel that the fundamental issue that remains unanswered is whether X-inefficiency implies real inefficiency or whether it reflects a difference in the nature of the output or an omission from the firm's technology of factors such as motivation, incentive systems and managerial ability. Stigler states, "Thus X-inefficiency attributed to motivational factors characterizes as inefficiency either the existence and pursuit of other desired outputs or the expenditure of resources required for the optimal enforcement of contracts . . . There is no waste in this sort of X-inefficiency: waste is a foregone product that could be acquired for less than its costs" [1, p. 214]. If motivation, managerial ability and "know-how" are incorporated into the description of a firm's technology, we may observe various firms operating in a given industry with identical physical technologies but having dif-

ferent production possibility sets. If one were to measure the difference between the most "extreme" production possibility frontier and a less extreme frontier, or the difference between the ratio of output to conventionally-measured inputs, one would observe X-inefficiency. Yet this would not necessarily be waste in the sense of being able to obtain greater output with the same inputs for a given technology. What is needed to resolve this issue are methodologies and measurement techniques that will determine if indeed economic agents are operating off the frontier of their production possibility set or if certain inputs to the production process have been omitted or output has been inadequately measured.

Everyone reading Leibenstein's book will find it stimulating and thought-provoking, and those readers who have found neoclassical economic theory lacking in its ability to explain economic behavior will find that the book provides solutions to many of those deficiencies. Those readers who are generally satisfied with neoclassical theory may not be comfortable with either the analysis or the conclusions but will find that Leibenstein's microtheory indicates the directions in which the theory should be extended before its critics will be stilled.

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THOMPSON, R. G., et al., *The Cost of Clean Water*, Gulf Publishing Company, 1976, 129 pp.

A five year study entitled "National Economic Models of Industrial Water Use and Waste Treatment" done at the University of Houston is summarized in a series of three monographs: "The Cost of Clean Water", "The Cost of Electricity", and "The Cost of Energy".

The first of these is reviewed here and deals with ammonia, chlor-alkali and ethylene production. Micro level linear programming models were developed for each of these industries for aid to policymakers in answering questions concerning (1) changes to be made in production and wastewater treatment processes to remove various levels of pollutants from industrial wastewater; (2) the production cost increases necessary for attaining zero discharge of pollutants to the water streams; and (3) the pollutant discharges to the air and the land resulting from zero discharge of wastewater pollutants.

The models describe hypothetical plants designed to use known or available technology and located geographically at Houston, Texas; Saginaw, Michigan; Sacramento, California; or Trenton, New Jersey. The models compute respective production cost increases of 3%, 5.6%, and 7% for zero discharge in ammonia, chlor-alkali, and ethylene plants.

This study illustrates the importance of the micro approach for policy-makers who need to know what will be the effects of major regulatory changes. By their na-

ture macro models cannot account for these effects when they are sufficiently important to result in major changes in production processes. An attractive methodological procedure is to use outputs of micro-models to modify coefficients of input-output models and to use these modified i-o models to get better data for macro models.

The book is well written and attractively put together. Each chapter has its bibliography and the model variables and the structural matrices are described in three appendices.

Modelling at this level is clearly needed if we are to be able to understand such tradeoffs as those between energy and environment and to chart a course for survival in the face of problems whose solutions are in conflict.

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