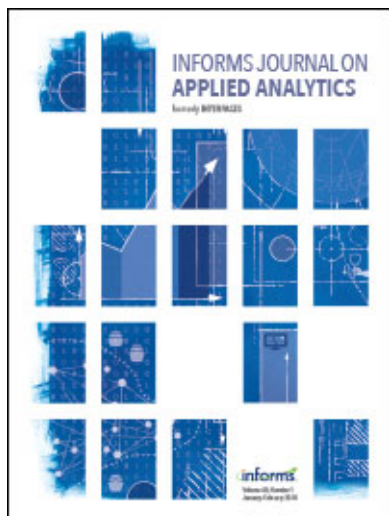




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The range of books reviewed is wide, covering theory and applications in operations research, statistics, econometrics, mathematics, computers, and information systems (no software is reviewed). In addition, we include books in other fields that emphasize technical applications. Publishers who wish to have their books and proceedings reviewed should send them to Professor Benjamin Lev, Department of Management, Worcester Polytechnic Institute, Worcester, MA 01609. We list the books and proceedings received; not all books received can be reviewed because space and time are limited. Those who would like to review books are urged to send me their names, addresses, and specific areas of expertise. We commission all reviews and do not accept unsolicited book reviews. Readers are encouraged to suggest books that might be reviewed or to ask publishers to send me copies of such books.

function, such as adaptation or learning with or without supervision, as well as lower-level functions, such as vision and speech pre-processing. The function of the simple processor and the structure of the connections are inspired by biological nervous systems." Hence, these networks are of interest to two broad research communities. One community, encompassing neurobiologists, experimental psychologists, and social scientists, is devoted to studying the bases of human or animal behavior. The other community,

This book is based on the proceedings of an April, 1986 conference in Snowbird, Utah. A neural network (Defense Advanced Research Projects Agency Study, 1987-88, p. 74) can be defined as "a system composed of many simple processors...whose function is determined by the connection topology and strengths. This system is capable of a high-level

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BOOK REVIEWS

comprising engineers and computer scientists, is devoted to improving the performance of computers or devising artificial systems for tasks (such as visual pattern recognition) that require processing of imprecise information.

While the field of neural networks has progressed rapidly since 1986, this book gives the uninitiated a good smorgasbord of many of its active research areas. It includes work by many leading contributors to the field: James Anderson, Andrew Barto, Walter Freeman, Stephen Grossberg, John Hopfield, Harry Klopff, Teuvo Kohonen, Bart Kosko, Terence Sejnowski, and Harold Szu, and about 50 others who are less well known. The methodology of Hopfield and his co-workers (see below) is somewhat dominant here. One of the articles even refers to Hopfield's work as "the standard neural network model." But calling one approach "standard" is incorrect because neural network structures and the tasks for which they are designed have been quite diverse. Also, Hopfield networks have had their major successes so far in optimization problems, and not all behavior is optimal (see Levine [forthcoming]).

Denker's book is hard to read because it is not broken down by subtopics. The articles are four to eight pages long, with two exceptions, and arranged in alphabetical order by author. Nor does the preface give clues to what subtopics are covered. Hence, the reader skimming this book learns about neural networks in a sequence of "sound bites." Articles discussing simulation of biological data are jumbled in with those proving mathematical theorems about types of networks, or

describing implementations of network hardware. In fact, the neural network field is not as chaotic as it looks here; some general modeling principles are used widely, though not universally [Levine forthcoming]. But it is hard to glean principles from this collection of short articles.

This book's articles can, however, be placed in four broad categories. The first and largest category is computational theory. This includes work by Abu-Mostafa; Anderson and Abrahams; Babcock and Westervelt; Baldi and Baum; Baum (two articles); Bruce et al.; Cohen; Denker; Gardner; Goles and Vishniac; Hertz et al.; Hoffman et al.; Jeffrey and Rosner; Kanerva; Keeler; Lapedes and Farber; Maxwell et al.; Mjolsness and Sharp; Mooppenn et al.; Personnaz et al. (two articles); Platt and Hopfield; Psaltis and Park; Saylor and Stork; Sejnowski; Sibani; Szu; Thakoor et al.; and Venkatesh.

The majority of these computational theory articles build on the previous work of Hopfield [1982] and Hopfield and Tank [1985], which was important to the recent neural network revival. Hopfield and Tank took network approaches (nonlinear and analog) that were over 10 years old but described them in ways that were widely understood. Some of their descriptions of network dynamics made analogies to ideas from physics (energy surfaces and magnetic spins). Their work also drew notice from computer scientists because it discussed hardware realizations of neural networks and used one to solve a classical optimization problem, the traveling-salesman problem. Based on the Hopfield formulation, many of the articles

in this book proved general theorems on network behavior. Others described variants of Hopfield-Tank networks that improved their performance on the traveling-salesman problem or (in the case of Abu-Mostafa) argued that neural networks were not the most cost-effective computational method for this type of problem.

Two other network mechanisms are well represented in this first set of articles. Simulated annealing, discussed in the articles of Szu, Gardner, and others, uses random noise to facilitate transitions from "undesirable" to "desirable" stable states of a Hopfield-like neural system. The Boltzmann machine, discussed in Sejnowski's article, embodies a different use of randomness.

A second group of articles falls in the category of neural network theory. The methods in these articles are motivated, more than in the first group, by specific cognitive tasks. This includes work by Anderson and Murphy, Carpenter and Grossberg, and Pearlmutter and Hinton on pattern classification and concept formation. For those familiar with the names, Anderson and Murphy used brain-state-in-a-box theory. Carpenter and Grossberg used adaptive resonance theory, which fits into an interrelated set of theories for such functions as visual preprocessing, Pavlovian conditioning, perceptual segmentation, and motor control [Grossberg 1988]. Pattern classification is the commonest application of neural networks, because such networks can make judgments on imprecise data bases.

Articles on other aspects of pattern processing include work on visual images

by Hérault and Jutten, Miyake and Fukushima, Grzywacz and Yuille, and Grant and Sage; the latter compared a Hopfield neural net with a nonneural-net approach. Buhmann and Schulten, Divko and Schulten, and Ritter and Schulten used networks with random elements for pattern recognition and motor control. Fianty, Gold, and Kohonen and Makisara applied various neural networks to speech and language understanding, another area of strong applied interest.

This second group also includes the Cruz-Young et al. article on knowledge representation, an area where neural network research is still young. Klopff and Kosko, in separate articles, discussed learning laws, both based on similar dynamics (connections changing as a result of stimulus changes) but one inspired by animal psychology and the other by philosophy and mathematics. Barto embedded learning and reinforcement in a network with competition and cooperation between nodes. Parker discussed an error-correcting learning rule similar to the popular back-propagation rule of David Rumelhart and his colleagues. Bounds studied learning in Boltzmann machines. Kanerva and Sasiela focused on aspects of memory.

Many network principles used in this second set of articles — modifiability of connection strengths, competition between nodes coding different sensory stimuli, and feedback between higher- and lower-level processing areas — have been supported by physiological results. But a third set of articles in this volume consists of more explicit models of specific biological systems. Many of these are

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from Freeman's laboratory at Berkeley, which is devoted to the olfactory system. Since the late 1960s, Freeman has been a leader among neurobiologists in quantitative analysis of data (he has recently used chaos theory). Articles from his laboratory include those by Baird (which is very mathematical, using dynamical systems), Colvin et al., Eeckman and Freeman, and Grajski and Freeman. Articles of a biological cast from other workers are by Mueller and Lazzaro (speech recognition), Travis (auditory processing), and Pellionisz (sensory-motor control). The large community of vision researchers is represented only by Hutchinson and Koch's article on filling in incomplete parts of visual images.

Finally, this book includes several articles on specific hardware for neural-like computation. The technologies discussed here include optical computing (D. Anderson and Farhat); digital signal processing (Penz et al.); VLSI (Graf et al., Hubbard et al., Sivilotti et al.); integrated circuits (Sage et al.); and crystalline materials (Spencer). Three years later, industrial hardware for neurocomputing is still diverse. The area is an active one for entrepreneurship, with no company or device cornering its market.

This wide variety of articles reflects the period when they were written: during the early boom in neural networks. In 1989, the field is still booming but more mature. Three neural network conferences, sponsored by either IEEE (Institute of Electrical and Electronics Engineers) or INNS (International Neural Network Society), have had nearly two thousand attendees each, and there will be two more

within a year. (INNS also sponsors a journal, *Neural Networks*, published by Pergamon.) All these meetings have been divided into sessions with subtopics. In addition, more specialized meetings have taken place; for example, Dallas-Fort Worth has had symposia on Motivation, Emotion, and Goal Direction in Neural Networks and on Neural Networks for Adaptive Sensory-Motor Coordination. Denker's book is organized more haphazardly than later conference proceedings. It is also biased toward one approach, but most leading books in neural networks are biased toward one or another school (one reason why I am now writing a general textbook [Levine forthcoming]). For all its faults and all the progress that has been made since it was written, Denker's book remains a valuable source for the field.

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DE KEYSER, VERONIQUE; QVALE, THORALF; WILPERT, BERNHARD; AND RUIZ QUINTANILLA, S. ANTONIO, eds. 1988, *The Meaning of Work and Technological Options*, John Wiley and Sons, New York, 228 pp., \$69.95.

Advances in the technologies of micro-electronics, software, computers, and communications have prompted the authors of this book to scrutinize how new information technology (NIT) might change the work experience. The second volume of a "New Technologies and Work" series generated by an interdisciplinary study group sponsored by the Werner-Reimers-Foundation (Bad Homburg, FRG) and the Maison des Sciences de l'Homme (Paris), this book brings a variety of different theories, research methods, and perspectives to the question of the impact of NIT on the meaning of work for individuals, organizations, and western societies.

Chapter 1 consists of brief review of the concept "meaning of work," including an historical perspective. It also delineates the psychological dimensions of the concept and conjectures their relationship to technological change. Chapter 2 describes the development of new information technologies and discusses the capability of NIT to integrate activities across production activities, industrial sectors, and national borders. Chapter 3 provides an overview of the research strands important to any assessment of NIT impacts, such as studies of work-related values, working conditions (especially quality-of-life), and the integration of work and nonwork roles. The question of how technology will be perceived and experienced

by those whose work is changed by it is taken up in Chapter 4, with individual, national, and worker participation differences thwarting attempts to generalize.

Braverman's [1974] work provides the intellectual backdrop to the next four chapters. Based on data from eight countries, the author of Chapter 5 warns that new job and organizational designs stemming from technical innovation should reflect not simply quality and efficiency criteria, but workers' preferences for non-instrumental rewards; that is, autonomy and the opportunity to learn and use their abilities. Chapter 6 provides an illustrative case study by describing the dysfunctional behavior and downgrading of skills that arises as mail sorting jobs are automated. Chapter 7, another case study of management's drive for increased productivity and control through automation, describes the concomitant neglect of worker skills and learning opportunities; though this need not be inevitable, the author argues, if the outcomes of technological change on work and the possibilities for retraining are considered and tested in advance. Chapter 8 presents two illustrative cases to advance the view that expert and decision support systems should not be developed without consideration of their impact on the social structure. Systems should support, not replace, users and their discretion in their jobs.

Chapters 9-14 concern the major approaches used to study NIT and work meanings. Chapter 9 demonstrates the sociotechnical systems perspective on the importance of incorporating human and social components into solutions to

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engineering and technical problems. The authors review methods of task analysis in Chapter 10 and present them as useful tools for assessing the impact of new technologies on work. In Chapter 11, they describe the strength of integrating both human and work-situation variables into models of work activity, as evidenced by the field studies tradition of the French school of ergonomics. The possibility of making laboratory experiments, field experiments, and pre-post comparisons relevant and applicable to research on NIT is explored in Chapter 12. Chapter 13 presents an "acting systems design" approach to designing work, which explicitly analyzes the behavioral processes involved in executing tasks. The chapter also summarizes the implications of action theory [Hacker 1985; Rasmussen 1983] for establishing guidelines for the design of interactive computer systems. Norway's national research program on computers at work — described in Chapter 14 — employs a cross-disciplinary perspective to avoid unintended human and organizational consequences and resource losses that could result from applying technology without taking into account of what is known about organizational change and the country's tradition of work place democracy. Chapter 15 summarizes the common themes and conclusions emerging from the previous chapters.

This book will interest academicians concerned with the sociology of work and industrial psychology. The array of issues raised is broad; occasionally a topic is treated too briefly to satisfy readers with more than a passing interest. That the authors do not resolve such issues as worker

participation in designing technological change, deskilling and the degradation of work due to automation, and management cognizance of the human and social considerations accompanying control through technology improvements is a strength of this collection, for it points to the challenges ahead for all those interested in what happens in the work place.

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HAGE, JERALD, ed. 1988, *Futures of Organizations: Innovating to Adapt Strategy and Human Resources to Rapid Technological Change*, Lexington Books, Lexington, Massachusetts, 302 pp., \$45.00.

As with so many books these days, this book has a somewhat misleading main title and a more relevant subtitle. Contrary to the claim in the foreword, the book is not about "what behavioral and social sciences suggest human organizations will look like in the future." Indeed, as a professional member of the World Future Society, I am more than a little disappointed that the pertinent literature in the field of futures research has been completely ignored. The focus of the book

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is better reflected in the topics of its four parts: strategies and structures; the impact of new technology and knowledge on managerial roles; ditto for nonmanagerial roles; and motivation and human resource management.

The book is the result of a conference organized by the Center for Innovation at the University of Maryland. There are 13 papers and an epilogue. As conference-based volumes go, this one is presented better than most. The editor has taken considerable care to provide the reader with overview comments on each of the four parts as well as an introductory chapter on what he calls "the new rules of competition." With a bibliography and an index, the book goes beyond the traditional conference production.

Each of the four parts of the book contains three papers. The first part is concerned broadly with alternative organizational structures. The subject of choice of strategies is unfortunately relegated to a distinctly subordinate position. The papers in the second part are probably the most valuable. They come closest to giving us a glimpse of what conditions are likely in the future. In particular, the paper by Delbecq and Weiss (Chapter 7) provides interesting insights into the role of the peculiar social and ecological milieu of Silicon Valley in the institutionalization of innovation and entrepreneurship. The third part covers the topic of how nonmanagerial roles are affected by new knowledge and technology. This is a welcome topic and, I suspect, one that will grow in importance in the coming years as the selection and training of workers become more complex with rapid

technological and other changes. The last part deals with motivation and human resources management, with no surprising prognostications for the reader.

I will make a few overall comments about the book: First, around 70 percent of the chapters are contributed by authors who are affiliated with the University of Maryland (10 out of 15 contributors and 9 out of 13 chapters). This perhaps accounts for a certain insular and limited view of organizations in the future (not "futures" of organizations, as the book's title proclaims). There is also no overarching sense of the kinds of organizations that are anticipated in the future. Even standard notions such as the "future factory" are not addressed, either in strategic or organizational terms.

Second, as may be expected, the chapters are of uneven quality. The paper on "Managing climates and cultures: A futures perspective" is an example of an amateurish foray into the subject. With such a lively and dynamic research area, the authors have chosen to cite 43 books and book chapters as against a mere 13 journal articles. Too, several "in press" items have been mentioned, without any effort to enlighten the reader as to titles, publication outlets, and so forth. Given the rich corpus of reputable journal articles available, there is little justification for leaning so heavily on book chapters.

Third, the index consists mostly of author names and nothing of the "detailed cross-references" that are promised (p. xvi); a book of miscellaneous topics would naturally have benefited from proper cross-referencing of key terms.

My final comment has to do with the

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relevance of the material to the real world of practitioners. The epilogue reflects a laudable concern for the practitioner's viewpoint (although the contributors are exclusively from academia). The editor issues a plaintive appeal to managers to engage in more experimentation in their organizations. As a business executive for a number of years, I find this at once trivial and revealing. Managers experiment day in and day out to survive in a competitive environment, mainly because there is no alternative to taking risks and shooting in the dark and playing on informed hunches — in short, experimentation in all its possible connotations. Managers certainly cannot rely on academics to experiment, refine, and prescribe the tried-and-true way! The naivete of the academic researcher is revealed in his ignorance of the fundamentally experimental, trial-and-error character of real-world "managing."

All this is not to take away from the value of the book, in that it underscores the increasingly critical role that innovation will play in the competitive business world of the future. However, it seems that we would need more innovative and substantive efforts to even begin to sketch the futures of organizations. A good starting point for that exercise would be the recognition that the concept of the future is itself highly problematic; the future is not simply a sophisticated extrapolation of the past and the present. I wish that those at the conference that spawned this book had deliberated upon the basic question of what exactly is meant by the future of an organization. Otherwise, as has happened, they are likely to succumb

to the convenience of foisting onto the future a reincarnated present.

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HAYES, ROBERT H.; WHEELWRIGHT, STEVEN C.; AND CLARK, KIM B. 1988, *Dynamic Manufacturing*, The Free Press, New York, 429 pp., \$24.95.

The authors espouse the thesis that the decline in America's productivity was caused primarily by the improper behavior of America's managers and not by incorrect fiscal, monetary, or trade policies. To improve their companies, managers ought to begin by reducing confusion and by motivating and managing the learning process. As processes become more sophisticated and more automated, success is becoming less a matter of substituting technology for people and more a matter of developing human skills simultaneous with technology and managing them in such a way that they reinforce each other.

Writing primarily for general managers, the authors go beyond the structural decisions — the "bricks and mortar" of facilities and equipment — to the infrastructure of a manufacturing company: the management policies, systems, and practices that must be at the core of a world-class organization. Most importantly, they address the difficulty of creating that infrastructure, emphasizing the management leadership and vision that are required.

They explore in depth such key infrastructure issues as capital budgeting, performance measurement, organizational

structure, and human resource management, demonstrating how they interact to foster the growth of productivity, the development of new products, and the creation of competitive advantage.

They contend that too many managers try to steer their companies using accounting data on monthly profits and losses that are too narrow in focus and too static in perspective. The authors' suggest a more valid and dynamic measurement system, namely a productivity measurement system that measures the ratio of actual outputs to actual inputs continuously over a long time frame. They demonstrate the usefulness of a productivity measurement system by using it to compare two factories.

This book points out the weaknesses of traditional management practices, which are built into authoritarian, hierarchical organizations. The authors show how many companies today are breaking out of this "command and control" mentality and creating a whole new set of relationships among workers and managers; engineering, marketing and manufacturing; and suppliers and customers, which is giving them a competitive advantage in the international marketplace.

This book together with the earlier book written by Hayes and Wheelwright, *Restoring Our Competitive Edge*, will provide usable, albeit somewhat long and difficult-to-coordinate, texts for a course in manufacturing strategy. These two books do not provide the concise and coherent coverage or cases for analysis that other possible texts do, for example, Hill's *Manufacturing Strategy*, but they do contain more original material. Unlike

many books providing advice on how to cure America's manufacturing ills, much of the advice in *Dynamic Manufacturing* is based on original research conducted by the authors. For this reason, I see this book being used more as a reference than as a text.

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RAND, GRAHAM K. ed. 1988, *Operational Research '87*, North Holland, Amsterdam, The Netherlands, 972 pp. \$184.25.

Operational Research '87 contains the proceedings of the 11th IFORS International Conference which was held in Buenos Aires in August 1987. IFORS (International Federation of Operations Research Societies) is the confederation of OR societies from around the world. Its major activities are its conferences, which are held every three years. The proceedings provide a record of the state of operations research worldwide. Unfortunately too many of us see only the work in our own country and are unaware that the same problems are being faced elsewhere and that often solutions have already been developed. The proceedings serve the important purpose of informing both practitioners and researchers about what is going on globally.

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The book presents only a sample of the papers given. It includes plenary papers and national contributions, outstanding papers that were refereed, and the papers that won or received honorable mention for the Third World Prize. This prize, a modest \$500, was awarded to a national of a third world country submitting a paper on a successful application of OR to a real problem in a third world country.

The book presents papers in 11 areas; they include papers that describe activities in a particular country, decision support systems, manufacturing and control, energy and natural resources, transport, and location. Most of the papers start with a problem and try to solve it. Only a small number of papers are methodological. In other words, these papers represent the essence of OR. The papers in almost every area express geographic diversity. For example, the papers on decision support systems come from Canada, Egypt, France, India, Japan, Mexico, South Africa, and the United Kingdom. Truly, OR is everywhere.

Like all proceedings of large, diverse meetings, the content is broad and it takes a little digging to find the gems. This is not a book you would read from cover to cover. Rather, it is a book that widens your outlook and provides a perspective on where your own work fits on a global scale. Although these proceedings are extremely expensive, the book deserves a place in university and organizational libraries. No other single source, except the *International Abstracts in Operations Research*, gives as rapid access to what is going on worldwide.

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