

Book Reviews

Endless Frontier, Limited Resources: U.S. R&D Policy for Competitiveness (1996). Washington: Council on Competitiveness. 145 pages. \$25.00

The Council on Competitiveness describes itself as “. . . a nonpartisan, nonprofit forum of chief executives from the business, university and labor communities working together to set a national action agenda for U.S. leadership in global markets, technological innovation, and education and training that will raise the standard of living of all Americans” (p. 140). Names of its members and advisory council, listed at the back of the report give credence to their claim and show the diversity of talent that makes up the organization. Therefore, its statement on national R&D policy deserves attention.

This report has three objectives: to assess the current status of R&D in the nation, identify appropriate roles for all sectors in the R&D effort, and suggest policy guidelines to help fill some of the identified gaps. The assessment is deductive and based on case studies of six major industries: aircraft, automotive, chemical, electronics, information technologies, and pharmaceuticals. These cases comprise four-fifths of the report and, by themselves, provide interesting reading, for example, the section on aircraft covers interesting highlights of the Boeing 777 project and NASA’s High Speed Research and Advanced Subsonic Technology projects.

The report debunks the linear model of innovation and the polarizing distinction between applied and basic science, emphasizing instead the complex and interactive nature of R&D. It suggests a three-way split of research types: short-term, low-risk; mid-term, mid-risk; and long-term, high risk. The first two categories are considered to be the acceptable realm of industry R&D, the last two of government R&D, and the third and final category for university R&D. The report suggests that this distinction will help inform a broader national debate on R&D goals and provide impetus for a more stable and consistent federal role in the national R&D effort.

The second major finding is that limited resources and the pressures of global competitiveness over the past 10–15 years have contributed to two outcomes—a significant restructuring of R&D activities away from corporate labs, toward suppliers and universities, and a refocusing of R&D toward shorter term market applications and away from longer term, higher risk projects. Centralized corporate labs have been downscaled, and companies are increasingly relying on first-tier suppliers, business units and universities to conduct R&D. This restructuring has reduced costs for the corporation, increased the rate of innovation, and brought R&D closer to the market and more in line with specific firm core competencies. Universities, feeling the pinch from continued declines in federal R&D spending, have gradually shifted their research to-

ward short- and mid-term research needs in response to increased corporate funding. Government labs have also been scrambling to readjust their research efforts toward civilian niches that focus more narrowly on specific areas of R&D that, at least in theory, provide greater support for U.S. competitiveness.

The third major finding, and overall theme of the report, is the expansion of inter- and intra-sectoral R&D partnerships. By far, the single most obvious response of all three sectors to limited resources has been an increasing reliance on alliances that simultaneously reduce R&D costs to individual companies, and provide access to external expertise through leverage of their own internal talent. “[Partnerships] vary widely in scale and scope, from company-to-company tie-ups to complex networks involving all three of the stakeholders in the innovation process” (p. 3). With the six case studies as evidence, the Council considers the restructuring to be significant enough to call it a new paradigm for R&D.

The fourth and final finding is simple—the trends discussed above will continue. All sectors will experience increased resource constraints. Corporations will further devolve and sharpen their R&D roles and responsibilities. There will be a subsequent increased emphasis on short-term, low-risk R&D across the nation. And the structural movement toward partnership as a means of leveraging defined skills and expertise, while maintaining multidisciplinary approaches to problems solving, will deepen.

The report provides a set of policy guidelines for industry, government and academia. Industry should increase its investment in U.S. R&D, both in response to global competitiveness challenges and because federal funding is on the decline. Inherent barriers to collaboration and partnership in the private sector need to be reduced—especially in the areas of long-term research. For government, the council pushes support for critical technologies with civilian applications, promotion of partnerships, regulatory and tax support for R&D, tighter scoping of missions and budgets, and finally, continued support of universities. Academia needs to strengthen its role as a producer of human capital and as a partner to industry and government.

While there are no real surprises in these assessment, findings or guidelines, *Endless Frontier, Limited Resources* is informative and speaks knowledgeably about the current and future status of R&D efforts in the U.S. Its policy guidelines are relatively balanced, favoring few changes in the current system but offering a few tweaks to maintain or extend the competitive position for U.S. industry. Nevertheless, there are omissions and oversights that need to be addressed.

The report speaks broadly to a need for the nation to develop a consensus on R&D goals and critical technologies, it speaks specifically to the immediate need for all

sectors to push partnerships. Consensus addresses planning operations, while partnering, as is presented in the report, describes a response by all three sectors to limited resources in a competitive environment. The report does not reconcile these two very different functions, preferring instead to concentrate on mechanisms for streamlining and simplifying the partnership process. National goals are assumed to naturally embody critical technologies and economic competitiveness. I submit that national goals are more complex.

In addition, there is a large bias in the cases selected for analysis. All six industries studied are large, well established, and very competitive in global markets. Only in two small sections of the electronics case—optoelectronics and flat panel displays—are there concerns raised about sunrise industries and U.S. dominance. Surely partnerships, especially between government and academia, are critical in these areas and differ in recognizable ways from partnerships in other industries. The report does an insufficient job of guiding planning with respect to different characteristics of the industries involved.

The industries and the cases themselves fail completely to address limitations of energy, natural resources, and clean environment. These industries are treated in a traditional way—according to the government department represented either as a source of partnering or as a source of regulation. It is disappointing, in an era when economic resources represent only one portion of the limitations and drivers for partnership, that the Council on Competitiveness could not better address how non-economic forces are affecting partnerships and national R&D objectives. Furthermore, the report lost an opportunity by ignoring what probably represent some of the most important future research frontiers.

Finally, the report is unsure about how to treat basic science research. The title “Endless Frontiers . . .” appeals to the cultural legacy left by Vannevar Bush, that basic research provides the foundation for economic growth, productivity improvements and the betterment of society. While the authors choose to apply the term more broadly than initially intended—to all R&D rather than only to basic science,¹ and while they attempt to reject the distinctions between basic and applied research, they remain nostalgic about the notion of an endless frontier. On the one hand, the report gives short shrift to basic research in its conceptual framework and in policy guidelines, preferring different terminology and a less epistemological approach. On the other hand, the report uses statistics on declines in funding levels for basic research funding to bolster concerns about the trends toward a declining fundamental research base. Throughout the report the authors seem undecided about how basic research relates to their own framework.

Part of the reason for the confusion is that basic

¹Bush, Vannevar. 1945. *Science: The Endless Frontier*. Washington, D.C.: The National Science Foundation.

research is a public good that serves multiple social purposes including economic competitiveness. Basic science research and public willingness to support basic science research is an important and unique part of the U.S. culture. It is one element that has made American universities and the nation strong. It is a model that often requires the passage of decades before benefits (direct and indirect) are realized. It is also a model that requires good management. However, funding of basic research needs to be undertaken by government (and other sources if possible) to support long-term economic competitiveness, further human knowledge, feed our spirit of curiosity, and improve society. Surely, it does not behoove us to reject the entire model in favor of short-term economic competitiveness—regardless the resource constraints. Probably the authors know all that. Otherwise the title would have been “Limited Resources, Limited Frontiers.”

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Stokes, Donald E. (1997). **Pasteur’s Quadrant: Basic Science and Technological Innovation**. Washington: The Brookings Institution. 180 pages, notes, index. \$38.95

Half a century ago, Vannevar Bush forged the fundamental views towards science and research in the process of technological change that still prevail today. These views continue to play a pivotal role in directing contemporary science policy in this country and elsewhere. The purpose of this insightful book is to challenge the conventional wisdom about the fundamental links between basic and applied scientific research. Most importantly, Stokes rejects the linear model suggesting that science is the driving force generating technological innovation. Instead, Stokes develops a compelling set of examples from the U.S. and Japanese experience to argue that the links between science and technology are interactive. An important policy conclusion is that applying the linear framework will tend to distort science policy. For example, it is widely accepted that basic science succeeds only to the degree that it is insulated from commercial applications.

In the first chapter Stokes traces the origins of the U.S. postwar science policy paradigm and succinctly describes the linear model of science and how it evolved into becoming the defining conceptual framework for American science policy. The second chapter traces the roots of science policy back to older traditions in Europe and even the ancient Greeks. The third chapter documents how the linear model was transformed into becoming the underlying framework for U.S. postwar science policy. This transformation has resulted in what the author terms as “the disarray of science and technology policy . . . especially in the United States,” and is described in Chapter Four. In particular, this disarray has been the result of the end of the

Cold War, globalization, and the political budgetary process. However, Stokes closes the chapter by calling for a renewed compact between science and the government. The concluding chapter of the book considers the role of basic science in the context of American democracy.

This is a rare book that will lead both policy makers and scholars to rethink many of their basic assumptions about science policy. The book is thoughtful, provocative and rewarding to read. It will prove to be invaluable to both experts in the field as well as those becoming acquainted with science policy for the first time.

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Books Received

Agre, Philip E. and Marc Rotenberg, eds. (1997). **Technology and Privacy: The New Landscape**. Cambridge, MA: MIT Press. 325 pages, index, \$25.00. The ten essays in this book present a conceptual framework for analysing privacy issues in the face of developments in such things as the spread of networking, major increases in communication bandwidths, and new techniques of cryptography and surveillance. Contributors are from diverse professional backgrounds, including academia, law enforcement, industry, and consulting on aspects of privacy, and include experts in communication, political science, economics, and the underlying technologies.

Bradley, Stephen P. and Richard L. Nolan, eds. (1998). **Sense and Respond: Capturing Value in the Network Era**. Boston, Harvard Business School Press. 350 pages, notes, index. \$45.00. Summarized from page proof copy in the Spring 1998 issue of *JTT*.

Bugliarello, George et al., eds. (1996). **East-West Technology Transfer: New Perspectives and Human Resources**. Dordrecht: Kluwer Academic Publishers. 318 pages, index. \$149. The book comprises 19 papers from a NATO Advanced Research Workshop, co-sponsored by the Scientific and Technical Research Council of Turkey, dealing with technology transfer between the Cold War NATO nations and countries of the former Soviet block. Papers include discussions of legal issues, national technology policies, personnel requirements, and the experiences and problems of several nations, including Russia, Kazakhstan, the Kyrgyz Republic, Uzbekistan, the Central and Eastern European nations, Finland, Sweden, Turkey, and the United States.

Chorafas, Dimitris N. (1998). **Transaction Management: Managing Complex Transactions and Sharing Distribu-**

ted Databases. New York: St. Martin's Press. 322 pages, bibliography, index. \$65. The Preface describes this book as "intended to appeal to information technology managers and systems experts confronted with the implementation of a transactions environment." Based on research in over 100 companies in the U.S., Europe and Japan, it provides advice on the management of complex transactions and share distributed data bases on client servers and the internet. Long and global transactions are emphasized.

Feinstein, Charles and Christopher Howe, eds. (1997). **Chinese Technology Transfer in the 1990s: Current Experience, Historical Problems and International Perspectives**. Cheltenham, UK: Edward Elgar. 254 pages, index. \$85.00. This book presents papers by twelve academicians, six Chinese and Six British, who participated in a 1995 seminar to examine scientific policy, R&D, and technology transfer in the People's Republic of China, with special reference to the reform policy and encouragement of foreign direct investment. The British participants focused primarily on theoretical, historical, and international aspects of technology transfer and economic development, while the Chinese discussed their nation's policies, problems, and prospects, including unresolved issues currently under debate.

Harryson, Sigvald (1998). **Japanese Technology and Innovation Management: From Know-how to Know-who**. Cheltenham, UK: Edward Elgar. 272 pages, bibliography, index. \$80.00. The theme of this book is that companies in high-tech markets can no longer rely on their own specialized technical competence for timely and appropriate responses to competitive and market shifts, but must develop the capability to access and acquire the most current knowledge—i.e., draw less on internal "know-how" and more on external "know-who" to borrow from. This involves open sharing of ideas, technologies, and human resources. The argument is bolstered by three in-depth case studies, of Canon, Sony, and Toyota.

Howells, Jeremy and Jonathan Michie, eds. (1997). **Technology, Innovation and Competitiveness**. Cheltenham, UK: Edward Elgar. 256 pages, index. \$80.00. Technology, innovation, and competitiveness are considered from an international perspective in the nine papers comprising this book, as these papers were presented at the first of a series of "Euroconferences" entitled "The Globalization of Technology: Lessons for the Public and Business Sectors." Topics covered include the globalization of research and technology, the effects of this globalization on the product life cycle, the role of financial institutions in the global economy, the consequences of finance for structural competitiveness, and the policy implications of recent developments.

Iansiti, Marco (1998). **Technology Integration: Making Critical Choices in a Dynamic World**. Boston: Harvard

Business School Press. 249 pages, bibliography, index. \$35.00. Technology integration, or the process of choosing the appropriate combination of technologies to integrate into a product from a large and complex assortment available, is often the key feature distinguishing successful from unsuccessful product development performance, according to the basic argument of this book. A study of the experiences of more than fifty companies in the software and computer industries concludes that technological choices made before the product development stage are crucial to the end results. Although the book focuses on the computer industry, the findings are considered relevant to any firm implementing novel technologies.

Jasanoff, Sheila, ed. (1997). **Comparative Science and Technology Policy**. Cheltenham, UK: Edward Elgar. 673 pages, name index. \$235. This book consists of reprints of 27 recent leading articles on science and technology policy plus an editor's Introduction, organized into six topical areas: science, technology and the state; governmental support for science; cross-national perspectives on technology policy; cultures of innovation; regulatory politics and policy; and international influences and national policy. Contributions are from various disciplines including economics, political science, law, and science and technology policies, covering a number of divergent views.

National Academy of Engineering (1998). **Frontiers of Engineering: Reports on Leading Edge Engineering from the 1997 NAE Symposium on Frontiers of Engineering**. Washington: National Academy Press. 135 pages. \$29.00. This book is the third and most recent in a series containing extended abstracts of the presentations made at the NAE symposia, Frontiers of Engineering. It contains descriptions of new research and technologies, and the benefits they may bring, in biomechanics, sensors and control for manufacturing processes, safety and security issues, decision-making tools for design and manufacturing, and intelligent transportation systems.

Poterba, James M., ed. (1997). **Borderline Case: International Tax Policy, Corporate Research and Development, and Investment**. Washington: National Academy Press. 168 pages, index. \$39.95. In his introduction the editor of this volume notes that as the trend toward global firms continues, one vital feature of the business environment that remains dependent on a firm's nominal nationality is its tax treatment. The book contains eleven papers presented at a 1997 conference held at the National Academy of Sciences, exploring the impact of the U. S. tax code on basic research outlays, expenditures on product and process development, and plant and equipment investment in the international activities of U.S.- and foreign-based firms, including prescriptions and prospects for tax reform.

Victor, Bart and Andrew C. Boynton (1998). **Invented Here: Maximizing Your Organization's Internal Growth and Profitability: A Practical Guide to Transforming Work**. Boston: Harvard Business School Press. Approximately 242 pages, notes. \$29.95. The core of this book is a discussion of how organizational knowledge can transform work in an era of rapid technological change, economic growth, and increasing globalization of markets. The authors contend that managers must regularly assess their own firms' existing knowledge bases and distinctive competencies rather than rely on the experiences of other firms or the general strategies advocated by management consultants and academicians. The argument is bolstered by a number of examples from a highly diverse set of companies. (page proof copy)

The *Journal of Technology Transfer* welcomes book reviews prepared by its readers. A reader interested in submitting a review of any of the above listed books is encouraged to contact the Book Review Editor at the address shown on the inside rear cover. Reviewers will be sent complimentary copies.

Reader Participation Survey

A forthcoming issue of the *Journal* will publish a two-part article by Lesley Cameron, William Finan, and William Morgan of the economic consulting firm Horst, Frisch, Clowery & Finan. The articles will provide an overview of international tax considerations, especially issues related to what is called transfer pricing, and their influence on the structure of technology transfers. The first part will discuss the general principles of the tax treatment of technology transfers, especially among related companies. The second part will provide a series of case studies that illustrate how these principles are applied to a hypothetical company facing tax decisions related to cross-border intercompany technology transfers. Needless to say, tax issues are complex and can frequently be difficult to grasp by non-tax professionals. Hence, we think a practical guide to tax considerations for readers of the *Journal* by these economic experts will provide a valuable primer for our readership.

In conjunction with the publishing of these articles, we are conducting a survey of our readers to gain insight into their exposure to the issues the authors plan to address. Cameron, Finan, and Morgan will summarize the survey results in their articles.

Please e-mail your responses to hfcf@hfcf.com.

1. A. Please identify your general professional affiliation below.
Government Education Private Sector

- B. If private sector, please identify your industry (e.g., electronics, automotive, aerospace, etc.).

2. Does your role include any of the following responsibilities?
 - A. Negotiating contracts or licenses that involve the transfer of technology to or from unrelated companies (third parties)?
Yes ____ No ____

 - B. Making final decisions regarding contracts or licenses with unrelated companies?
Yes ____ No ____

 - C. Preparing quantitative analyses (e.g., make/buy decision) of the implications of technology transfer agreements with unrelated companies?
Yes ____ No ____

3. Have you ever been questioned by your company's tax group regarding technology transfer issues?
Yes ____ No ____

4. Does your company evaluate financial results on a before- or after-tax basis in deciding about technology transfer?
Yes ____ No ____

5. Are you familiar with your company's legal structure?
Yes ____ No ____

In advance, the editors thank you for your participation in this reader survey.

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Manuscripts. Typed manuscripts submitted for review should be double spaced on 8½x11 white paper using a 12-point font to facilitate reviewing and editing. Including tables, diagrams, and references, the manuscript should not exceed 30 pages.

Three copies of the manuscript are needed for the initial review process. Each manuscript submitted for review should have a cover page with the names of the author(s), affiliation(s), complete mailing address(es), telephone and facsimile numbers, and e-mail address(es), if available. The second page should contain a detailed abstract not to exceed 150 words. The abstract should not only overview the paper but also emphasize how it informs and enhances the practice of technology transfer. The manuscript should begin on the third page; that page should have the title of the manuscript but not the name(s) of the author(s). Footnotes should be used only if absolutely necessary. References should appear at the end of the manuscript.

Initially submitted manuscripts need not conform to a particular manuscript style other than those noted above. Authors will be sent a detailed style sheet if their paper is accepted for publication or invited to be revised and resubmitted. Style sheets are available from the co-editors upon request.

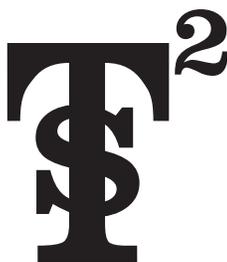
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