#### **BIOGRAPHICAL INFORMATION**

## **EDWARD B. ROBERTS**

## **Personal**

Born on November 18, 1935 in Chelsea, Massachusetts Married to Nancy Helen Rosenthal on June 14, 1959

Three children: Valerie Jo Friedman, Mitchell Jonathan Roberts, Andrea Lynne Roberts; nine grandchildren

## **Education**

S.B. M.I.T., 1958 (Electrical Engineering) S.M. M.I.T., 1958 (Electrical Engineering) M.I.T., 1960 (Management) S.M. M.I.T., 1962 (Economics) Ph.D.

# Professional Experience

| <u>Protessional E</u> | <u>xperience</u>   |
|-----------------------|--|
| 1958-85               | Co-Founding Member (as full-time Research Assistant to Jay Forrester), System Dynamics Group, M.I.T.   |
| 1959                  | Instructor, M.I.T. School of Industrial Management   |
| 1961                  | Consultant, National Aeronautics and Space Administration  |
| 1961-65               | Assistant Professor of Industrial Management, M.I.T.   |
| 1962-73               | Co-Founding Member and Associate Director, M.I.T. Research Program on the Management of Science and Technology; renamed as the M.I.T. Research Program on the Organization and Management of Research & Development (1965), the first program of its kind in any school of management. |
| 1963-69               | Consultant, The RAND Corporation   |
| 1963-95               | Co-Founder and Chairman, Pugh-Roberts Associates (President and Chief Executive Officer until 1989), acquired by PA Consulting Group, Ltd. (1991)  |
| 1964-                 | Founder, M.I.T. Research Program on Technology-Based New Enterprises (funded by M.I.T. Center for Space Research, 1964-71), the first sustained program of research on technology-based entrepreneurship.  |
| 1965-70               | Associate Editor, Management Science   |
| 1965-70               | Associate Professor of Management, M.I.T. (awarded tenure, 1969)   |
| 1966                  | American Marketing Association, Award for Distinguished Contributions to Government-Defense-<br>Space Marketing  |
| 1966-70               | National Council, The Institute of Management Sciences (TIMS)  |
| 1966-~86              | MIT Alumni Council, various positions  |
| 1967-69               | Treasurer, Ecole Bilingue, Inc.  |
| 1967-70               | U.S. Air Force Scientific Advisory Board (including Psychology and Social Sciences Panel)  |
| 1967-72               | U.S. Department of Commerce Technical Advisory Board   |
| 1968-69               | James V. Forrestal Professor of Military Management, U.S. Naval War College  |
| 1968-70               | Task Force, Harvard Medical School Plan for a Comprehensive Community Health Care Program  |
| 1969-73               | Co-Founder and Keynote Presenter, M.I.T. Young Alumni Seminar Programs in Entrepreneurship (at M.I.T. and across the United States to ~3,000 MIT alumni)   |
| 1969-                 | Co-Founder and Director, Medical Information Technology, Inc. (Meditech)   |
| 1970                  | M.I.T. Alumni Association Presidential Citation  |
| 1970-                 | Professor of Management, M.I.T.  |
| 1971-74               | Co-Founder, European Management Symposium (later the World Economic Forum), Geneva and Davos   |
| 1972-73               | Consultant, U.S. President's Advisory Council for Management Improvement   |
| 1972-86               | Consultant, Association of American Medical Colleges (AAMC), and Co-Director of the AAMC Management Advancement Program  |
| 1973-89               | Chairman, Technology and Health Management Groups, M.I.T.  |
| 1974                  | Consultant, American College of Physicians   |
| 1974-                 | David Sarnoff Professor of Management of Technology, M.I.T.  |

| 1975-76        | U.S. Energy Research & Development Administration (ERDA) Task Force on Nuclear Medicine                                  |
|----------------|--|
| 1975-80        | Founder and Chair, M.I.T. Sloan Fellows Health Management Executive Development Program                                  |
| 1976-80        | Director, M.I.TBoston Veterans Administration Hospital Joint Center on Health Care Management                            |
| 1977-80        | National Advisory Council, National Center for Health Care Technology at University of Missouri-Columbia                 |
| 1977-83        | Board of Governance, Veterans Administration Administrative Scholars Program   |
| 1978           | Co-Founder, M.I.T. Enterprise Forum  |
| 1978-83        | Associate Director for Health Policy and Management, and Faculty Advisory Council, M.I.T. Whitaker                       |
|                | College of Health Sciences, Technology & Management  |
| 1979-81        | U.S. National Research Council Committee on Federal Research on Biological and Health Effects of Ionizing                |
|                | Radiation  |
| 1979-88        | Chairman, Executive Committee, M.I.T. Whitaker College Program in Health Policy & Management                             |
| 1980-87        | Co-Founder and Director, M.I.T. Joint Program in the Management of Technology (MOT)                                      |
| 1982-99        | Co-Founder and General Partner, Seed Fund Associates, Zero Stage Capital and First Stage Capital                         |
|                | Equity Funds (including separately named funds in several states)  |
| 1984-87        | Member, multiple committees, Combined Jewish Philanthropies of Greater Boston, Inc.                                      |
| 1984-88; 97-98 | Executive Committee, M.I.T. Enterprise Forum of Cambridge  |
| 1985-92        | Executive Committee, New England Region, American Technion Society   |
| 1986-93        | Founder and Chair, Technion Entrepreneurial Associates (including creating the first programs in Israel                  |
| 1900-93        | on entrepreneurship and venture capital)   |
| 1006 07        |  |
| 1986-87        | U.S. National Research Council Task Force on the Management of Technology  |
| 1987-99        | Founding Faculty Chairman (later Co-Chairman), M.I.T. Management of Technology (MOT) Program                             |
| 1989-2003      | Chair, M.I.T. Management of Technological Innovation and Entrepreneurship (MTIE) Group                                   |
| 1990           | M.I.T. Alumni Association Committee on the Future of the Enterprise Forum  |
| 1990-2006      | Co-Founder and Faculty Sponsor, "Birthing of Giants" Program: MIT, Young Entrepreneurs Organization                      |
|                | (YEO, now EO), and Inc. Magazine   |
| 1990-94        | Partner, PA Consulting Group, London   |
| 1991-94; 97-   | Founder and Chair, M.I.T. Entrepreneurship Center, renamed as the Martin Trust Center for M.I.T. Entrepreneurship (2011) |
| 1991           | Association of American Publishers Award for "Outstanding Book of 1991 in Management and                                 |
|                | Business", for Entrepreneurs in High Technology: Lessons from MIT and Beyond   |
| 1992           | American Libraries Association Award for "Outstanding Academic Book of 1992" for <i>Entrepreneurs</i>                    |
|                | in High Technology   |
| 1993-2001      | Co-Director, M.I.T. International Center for Research on the Management of Technology (ICRMOT)                           |
| 1993-2002      | High Level Advisory Board, U.SIsrael Science & Technology Commission, U.S. Department of                                 |
| 1775 2002      | Commerce   |
| 1994           | Co-Founder, M.I.T. Enterprise Forum of Israel  |
|                | ,  |
| 1994-99        | U.S. National Research Council Task Force on Corporate Innovation in the United States and Japan                         |
| 1994-95        | U.S. Secretary of Energy Task Force on Alternative Futures for the D.O.E. National Laboratories                          |
| 1996-2017      | Co-Founder and Director, Sohu.com Inc. (initially Internet Technologies China, Inc.), Beijing                            |
| 1998-2002      | Advisory Board, Corporate Board Resource Committee, The Boston Club  |
| 1998-2009      | Co-Founder and Member, CommonAngels  |
| 1999-2006      | Executive Committee, Technology Industry Group, Combined Jewish Philanthropies of Greater Boston                         |
| 2000-02        | Massachusetts Governor's Economic Development Council  |
| 2000-05        | Steering Committee, Emerging Women's Program, The Commonwealth Institute   |
| 2002-10        | Co-Founder and Steering Committee, M.I.T. Biomedical Enterprise Program  |
| 2003-11        | Chair, M.I.T. Sloan Technological Innovation, Entrepreneurship & Strategic Management (TIES) Group                       |
| 2004           | Received with Nancy Roberts the Huntington Theatre Company Award for Outstanding Support and                             |
|                | Achievement  |
| 2004           | Award for Lifetime Contributions, Technology Management Education Association  |
| 2004           | Vincent Fulmer Lifetime Service Award, M.I.T. Enterprise Forum   |
| 2004-08        | Co-Founder and Member, Board of Directors, Littleton (NH) Museum of Fine Art   |
| 2004-          | Board of Directors, North Country (NH) Chamber Players, Franconia NH   |
|                | -,,,,  |

| 2005 00 | Advisory II C. National Institutes of Caismas O. Tashmalasy, Chydy of Campanata Vantuus Canital in   |
|---------|--|
| 2005-08 | Advisor, U.S. National Institutes of Science & Technology Study of Corporate Venture Capital, in cooperation with National Venture Capital Association |
| 2005-   | Advisory Board, Middle East Education through Technology (MEET), now renamed Middle East   |
| 2003    | Entrepreneurs of Tomorrow, Israel  |
| 2005-   | Founder and Faculty Director, M.I.T. Sloan Entrepreneurship & Innovation (E&I) MBA Track (co-Director,   |
| 2003    | 2020-)   |
| 2006    | International Center for Management of Engineering & Technology Award "For Distinguished Lifetime  |
| 2000    | Contributions to the Field of Technology Management and Innovation"  |
| 2006-12 | Board of Governors, Combined Jewish Philanthropies of Greater Boston   |
| 2008    | Awarded the M.I.T. Adolf F. Monosson Prize for Entrepreneurship Mentoring  |
| 2008-18 | Art of the Americas Visiting Committee, Museum of Fine Arts, Boston  |
| 2009    | Excellence in Research Award, International Association for Management of Technology   |
| 2009-   | Massachusetts Council, American Israel Public Affairs Council (AIPAC)  |
| 2009-10 | Beth Israel-Deaconess Medical Center, Research Strategy Committee on Accelerating Bench to Bedside   |
| 2009-11 | Co-Director, M.I.TPortugal Innovation & Entrepreneurship Program   |
| 2009-12 | Co-Developer, M.I.T. Regional Entrepreneurship Acceleration Program (REAP)   |
| 2010    | Dean's Award for Excellence in Leadership, M.I.T. Sloan School   |
| 2011-13 | Co-Chair, Innovation & Entrepreneurship, M.I.TSkolkovo Institute of Science and Technology   |
| 2014-15 | Advisory Council, Museum of the White Mountains, Plymouth (NH) State University  |
| 2015    | Participant, MIT Sloan "Great Thinkers" video series   |
| 2015-18 | Board of Overseers, SpeakEasy Stage Company  |
| 2015-   | Advisory Board, Center for Surgery, Innovation & Bioengineering, Massachusetts General Hospital  |
| 2016-   | Executive Committee, AIPAC Technology & Innovation Division  |
| 2017-   | Board of Advisors, Maverick Ventures (Israel)  |
| 2019    | Received with Nancy Roberts the Mayor Thomas M. Menino Memorial Award for Inspired Support of the Arts   |

**Honorary Societies**: Sigma Xi, Tau Beta Pi, Eta Kappa Nu.

**Service on MIT Committees:** Admissions and Student Aid, 1964-67; Committee on Industrial Liaison, 1968-71, Chair, 1968-69; Committee on Curricula, 1968-71, Chair 1969-71; Committee of Committee Chairs (appointed by Provost Rosenblith), 1968-69; Special Committee on ROTC, 1969-70; IAP Evaluation Committee, 1970-71; Staff-Administration Committee, 1972-73; Discipline Committee, Chair, 1973-74; Committee on Educational Policy, 1975-78; Admissions and Financial Aid, 1975-76; Committee on International Institutional Commitments, 1976-78; Lincoln Labs Review Committee, 1977-79; Committee on Undergraduate Program, 1985-86; Killian Prize Selection Committee, 1985; Ad Hoc Committee on Innovation and Entrepreneurship (appointed by Deans Schmittlein and Waitz), 2011-2013; Committee on Student Entrepreneurship (appointed by Dean Ortiz), 2011-2013; Faculty Policy Committee, 2014-2017.

Corporate Boards of Directors: Current: Medical Information Technology (co-founder, 1969-), PR Restaurants (1997-). Previous (alphabetical): Advanced Magnetics (formerly BioClinical Group, now AMAG Pharmaceuticals) (1982-2006), Cannonball (2015-2017, acquired by Google), Carousel Software (co-founder, 1982-1985), Cistran (co-founder, 2002-2003), Cooper Human Systems (co-founder, 2011-2017), Daktari Diagnostics (2009-15), Data Technologies (1967-1968), Digital Products (1993-1996, acquired by Osicom Technologies), DynoMedia (formerly UCAN-TV), Beijing (co-founder, 2006-2014), EdTech Networks (2007-2009), Education & Research Institute (founder, 1968-1995), Environmental Impact Center/EIC (co-founder, 1971-1976), Geodatic (1969-1970), Geophysical Survey Systems (1970-1977), HighPoint Systems (1994-2002), Ibtekar Venture Partners (co-founder, 2000-2007), Informative Computer Services (1968-1970), Interactive Sciences (1968-1970), Interactive Supercomputing (2005-2009, acquired by Microsoft), InTouch Systems (1998-1999, acquired by Comverse Technologies), Inverness Medical Technologies (formerly Superior Sensors, then Selfcare) (1992-2002, acquired by Johnson & Johnson), Laser Science (1987-1996, acquired by Thermo-Electron Group), NetSilicon (1999-2002, acquired by Digi International), OrgSupply (2002-2003), Pegasystems (1996-2005), Phillips Screw (1973-1978, acquired by Rule Industries), Public Sector (co-founder, 1971-1975), Pugh-Roberts Associates (co-founder, CEO, 1963-1990, acquired by PA Consulting Group), SofTech (1969-1974), Sohu.com (Beijing; formerly Internet Technologies China) (co-founder, 1996-2017), Solar

Power (1974-1975, acquired by Exxon Enterprises), StarNex (1998-2001), StarSure.com (co-founder, 2000-2001, acquired by ePolicy), Tyco Laboratories (1965-1967, now Tyco International), University Bank & Trust (1984-1987), Visible Measures (co-founder, 2005-2017, acquired by AdAcuity), Youth Dynamics (1968-1970), Zero Stage Capital Group (including First Stage Capital) (co-founder and General Partner, 1981-2000). Founding angel investor in many startup companies, including Advanced Magnetics, Cover Wallet, HubSpot, Locu, Okta and 3Play Media.

#### **Member of Journal Editorial Boards**

Served over many years as a member of the following Editorial Boards: IEEE Transactions on Engineering Management, Industrial Marketing Management, Journal of Product Innovation Management, Journal of Technological Innovation & Management, Research/Technology Management, Sloan Management Review, and Technological Forecasting & Social Change. Performed journal article reviews for these and many other academic journals.

#### Thesis and Dissertation

The Digital Computer as an Element of a Financial Control System (S.M. thesis, MIT Department of Electrical Engineering, May 1958).

The Dynamics of Research and Development (Ph.D. dissertation, MIT Department of Economics, June 1962).

# **Books and Monographs**

Problems in Industrial Dynamics (principal contributor) (Cambridge: The M.I.T. Press, 1963).

The Dynamics of Research and Development (New York: Harper & Row, Publishers, 1964). Published in Japanese by Toyo Keizei Shinpo Sha.

Systems Simulation for Regional Analysis: An Application to River Basin Planning (with H. Hamilton, et al.) (Cambridge: The M.I.T. Press, 1969) (published in Japanese by Kajima Institute Publishing Company).

*The Persistent Poppy: A Computer-Aided Search for Heroin Policy* (with G. Levin and G. Hirsch) (Cambridge: Ballinger Publishing, 1975).

The Dynamics of Human Service Delivery (with G. Levin, et al.) (Cambridge: Ballinger Publishing, 1976).

*Managerial Applications of System Dynamics* (editor) (Cambridge: The M.I.T. Press, 1978) (Republished by Productivity Press, Cambridge, 1993; republished by Pegasus Communications, Waltham MA, 1999).

Biomedical Innovation (with R. Levy, et al., editors) (Cambridge: The M.I.T. Press, 1981).

Generating Technological Innovation (editor) (New York: Oxford University Press, 1987). Published in Spanish with additional chapter as Gestion de la Innovacion Tecnologica (Madrid: Fundacion COTEC, 1996.)

Entrepreneurs in High Technology: Lessons from MIT and Beyond (New York: Oxford University Press, 1991). Published also in Chinese.

*Innovation: Driving Product, Process and Market Change* (editor) (New York: Jossey-Bass Division, John Wiley & Sons, Inc., 2002).

Entrepreneurial Impact: The Role of MIT (with C. Eesley) (Kansas City: Kauffman Foundation, 2009). Published also in Russian and Chinese (Cambridge: MIT, 2011).

Entrepreneurial Impact: The Role of MIT – An Updated Report (with C. Eesley) (Boston: NOW Publications, 2011).

Entrepreneurship and Innovation at MIT: Continuing Global Growth and Impact (with F. Murray and J. D. Kim) (Cambridge: MIT, December 2015).

Celebrating Entrepreneurship: A Half-Century of MIT's Growth and Impact (Cambridge: MIT, 2018).

Entrepreneurship and Innovation at MIT: Continuing Global Growth and Impact – An Updated Report (with F. Murray and J.D. Kim) (Boston: NOW Publications, 2019)

Celebrating Entrepreneurs: How MIT Nurtured Pioneering Entrepreneurs Who Built Great Companies, Second Edition (Amazon Books, 2020)

## **Reports of Governmental Commissions** (co-author)

Financing New Technological Enterprise: Report of the Panel on Venture Capital (co-author) (Washington, DC: U.S. Department of Commerce, 1970).

*Nuclear Medicine Research: An Evaluation of the ERDA Program* (with E. Potchen, et al.) (U.S. Energy Research and Development Administration, ERDA-76/135, August 1976).

- Federal Research on the Biological and Health Effects of Ionizing Radiation (contributor) (Washington, DC: National Academy Press, 1981).
- Management of Technology: The Hidden Competitive Advantage (contributing author) (Washington, DC: National Academy Press, 1987).
- Alternative Futures for the Department of Energy National Laboratories (with R. Galvin and others) (Washington, D.C.: U.S. Department of Energy, February 1995).
- New Strategies for New Challenges: Corporate Innovation in the United States and Japan (with L. Branscomb and others) (Washington, D.C.: National Academy Press, 1999, ISBN 0-309-05848-1).
- Corporate Venture Capital (CVC): Seeking Innovation and Strategic Growth (with I. MacMillan, V. Livada and A. Wang) (Washington, D.C.: National Institute of Standards & Technology Special Report GCR 08-916, June 2008).

# **Social Science Research Network** (partial listings of recent papers)

http://papers.ssrn.com/sol3/cf\_dev/AbsByAuth.cfm?per\_id=17432

## Publications on Industrial and Health Care Policy/Systems Analysis

- Industrial Dynamics and the Design of Management Control Systems, *Management Technology*, December 1963 (vol. 3, no. 2), 100-118.
- New Directions in Industrial Dynamics, Industrial Management Review, Fall 1964 (vol. 6, no.1), 5-14.
- Systems Methodology for Evaluating Industrial Projects in the Context of National Strategies, M.I.T. Sloan School of Management Working Paper #141-65, 1965.
- Systems Concept in Corporate Management Education, in *Proceedings of the Sixth Annual Training Directors' Conference* (Flint, MI: General Motors Institute, 1966), 1.1-1.22.
- A Systems Study of Policy Formulation in a Vertically Integrated Firm (with D. Abrams and H. Weil), *Management Science*, August 1968 (vol. 14, no. 12), B674-B694.
- Analyse Fonctionelle des Problemes d'une Entreprise de Confections", Direction et Gestion, January-February 1970.
- Implementing New Educational Technology for the Military (with H. Weil), *Naval War College Review*, April 1971 (vol. 23, no. 8), 22-28.
- System Simulation of Program-Patient Interaction (with D. Kligler, et al.), in *Proceedings of the 1971 Summer Simulation Conference* (Boston: July 1971).
- System Simulation in Watershed Planning, in *Proceedings of a Symposium on Lake Cochituate and its Watershed* (Chestnut Hill, MA: Boston College Environmental Center, 1971), 31-36.
- Narcotics and the Community: A System Simulation (with G. Levin and G. Hirsch), *American Journal of Public Health*, June 1972 (vol. 62, no. 6), 861-873.
- Diagnostic Report of the A.I.D. Organizational Change Modelling Project (with W. Killingsworth et al.) (Cambridge, MA: Pugh-Roberts Associates, Inc., 1974).
- Strategic Modelling for Health Care Managers (with G. Hirsch), *Health Care Management Review*, Winter 1976 (vol. 1, no. 1), 69-77.
- On Modelling, Technological Forecasting and Social Change, January/March 1976 (vol. 9, no. 1/2), 231-238.
- Videotape Series: (I) Strategic Planning: A Framework for Management Decision-Making; (2) Organizing for Strategic Planning; (3) Implementing Strategic Planning (Atlanta: National Medical Audio-Visual Center, National Library of Medicine, 1976).
- Systems Intervention: New Help for Hospitals (with N. Stearns, et al.), *Health Care Management Review*, Fall 1976 (vol. 1, no. 4), 9-18.
- Systems Analysis of Apparel Company Problems, DYNAMICA, Summer 1977 (vol.3, part 3), 105-131.
- Strategies for Effective Implementation of Complex Corporate Models, *TIMS-ORSA Interfaces*, November 1977 (vol. 8, no. 1), 26-33.
- A Medical Education Program Strategy for Community Hospitals (with N. Stearns and T. Bergan), *The Hospital Medical Staff*, January 1978 (vol. 7, no. 1), 20-25.
- Videotape Series: (1) Designing Medical Organizations: Underlying Concepts; (2) Designing Medical Organizations: To Matrix or Not (Atlanta: National Medical Audio-Visual Center, National Library of Medicine, 1978).
- Some Insights into Implementation, in E.B. Roberts (editor), *Managerial Applications of System Dynamics* (Cambridge: The M.I.T. Press, 1978), 155-161.

- Systems Analysis of Workload Fluctuations: A Case Study of the Precision Company, in E.B. Roberts (editor), *Managerial Applications of System Dynamics* (Cambridge: The M.I.T. Press, 1978), 163-184.
- A Systems Intervention for Improving Medical School Hospital Interrelationships (with N. Stearns, et al.), *Journal of Medical Education*, June 1978 (vol. 53), 464-472.
- A System Dynamics View of Substance Abuse (with G. Hirsch and G. Levin), in J.H. Lowinson and P. Ruiz (editors), Substance Abuse in the United States (Baltimore: Williams & Wilkins Company, 1981), 109-125.
- A Systems View of the Smoking Problem (with J. Homer, et al.), *International Journal of Bio-Medical Computing*, 1982 (vol. 13), 69-86.
- Why Do Occupational Physicians Need to be Better Managers? (with N. Stearns), *Journal of Occupational Medicine*, March 1982 (vol. 24, no. 3), 219-224.
- Representing Decision Processes, in N. Roberts, et al., *Introduction to Computer Simulation: The System Dynamics Approach* (Reading, MA: Addison-Wesley, 1983), 373-393.
- Health Information Systems, Medical Care, May 1985 (vol. 23, no. 5), 672-676.
- A Theory of Service Delivery and Its Application to the Drop-out Phenomenon (with G. Levin), in R. L. Levine and H. E. Fitzgerald (editors), *Analysis of Dynamic Psychological Systems, Volume 2: Methods and Applications* (New York: Plenum Press, 1992), 263-301.
- Making System Dynamics Useful: A Personal Memoir, *System Dynamics Review*, Summer/Fall 2007 (vol. 23, no. 2/3), 119-136. MIT Sloan Working Paper 4649-07, May 22, 2007.

# <u>Publications on the Management of Technology, Innovation and Entrepreneurship</u>

#### A. <u>Dynamics of R&D Projects and Organizations</u>

Simulation Techniques for Understanding R&D Management, *1959 IRE National Convention Record, Part 10* (New York: Institute of Radio Engineers, 1959), 38-43.

Toward a New Theory for Research and Development, *Industrial Management Review,* Fall 1962 (vol. 4, no. 1), 29-40. Model of a Research and Development Organization, M.I.T. Industrial Dynamics Research Memorandum D-511, October 23, 1962.

Engineer Dynamics and Productivity in R and D Projects, M.I.T. School of Industrial Management Working Paper #37-63, October 1963.

Strategies for Survival in the Aerospace Industry (contributor) (Cambridge: Arthur D. Little, Inc., 1964).

Research and Development Policy-Making, Technology Review, June 1964 (vol. 66, no. 8), 32-36.

Games and Models for Training Research Managers, M.I.T. School of Industrial Management Working Paper #116-65, February 1965.

A Systems Analysis of Multi-Laboratory Management (with S. Pathak), M.I.T. Research Report to Office of Naval Research, September 1967.

The Problem of Aging Organizations: A Study of R&D Units, Business Horizons, Winter 1967 (vol. 10, no. 4), 51-58.

The Dynamics of R&D Strategy (with H. Weil and T. Bergan), *Proceedings of the 1973 Summer Simulation Conference* (Montreal: July 1973); reprinted in E.B. Roberts (editor), *Managerial Applications of System Dynamics* (Cambridge: The M.I.T. Press, 1978), 325-340.

A Simple Model of R&D Project Dynamics, R&D Management, October 1974 (vol. 5, no. 1), 1-15.

Bibliography on Research and Development System Dynamics, *Newsletter of the TIMS College on Simulation and Gaming*, Spring 1980 (vol. 4, no. 2), 8-10.

#### B. Management of R&D Contracting

How the U.S. Buys Research, International Science and Technology, September 1964 (no. 33), 70-77.

Marketing and Engineering Strategies for Winning R&D Contracts, in *Adaptability for Survival in the Defense Industries* (Boston: Boston College Press, 1965), 93-113.

The Dynamics of Research and Development, in *Proceedings of R&D Symposium: Motivation and Support of R&D to Achieve National Goals* (Washington, DC: National Security Industrial Association, 1965), 25-38.

Improving R&D Procurement, *The Scanner* (Sylvania Electronic Systems), Fall 1965, 5-6.

Questioning the Cost/Effectiveness of the R&D Procurement Process, in M.C. Yovits, et al. (editors), *Research Program Effectiveness* (New York: Gordon & Breach Science Publishers, Inc., 1966), 93-113.

- The Measurement and Improvement of R&D Marketing Effectiveness, in *Changing Boundaries of the Defense Industries* (Boston: Boston College Press, 1966), 14-20.
- Effects of Incentive Contracts on Research and Development: A Preliminary Research Report (with J. Sloat), *IEEE Transactions on Engineering Management*, December 1966 (vol. EM-13, no. 4), 181-187.
- Follow-on Contracts in Government-Sponsored Research and Development: Their Predictability and Impact (with W. Dyer), *Industrial Management Review*, Winter 1968 (vol. 9, no. 2), 41-55.
- The Management of Department of Defense Laser Research Contracts (with W. Davis), *Journal of Business*, January 1970 (vol. 43, no. 1), 44-55.

#### c. General Management of R&D and Technological Innovation

- Research on the Management of Technology-Based Enterprises, *IEEE Transactions on Engineering Management*, September 1964 (vol. EM-11, no. 3), 99-102.
- Facts and Folklore in Research and Development Management, *Industrial Management Review*, Spring 1967 (vol. 8, no. 2), 5-18.
- Myths of Research Management, Science & Technology, August 1968 (no. 80), 40-46.
- Exploratory and Normative Technological Forecasting: A Critical Appraisal, *Technological Forecasting*, Fall 1969 (vol. 1, no. 2), 113-127.
- Foreword, in M. Cetron, et al., *Technical Resource Management: Quantitative Methods* (Cambridge: The M.I.T. Press, 1969), v-vii.
- Le Controle de l'Advancement des Travaux de Recherche et Developpement, *Synopsis*, May-June 1971 (vol. 3, no. 131), 19-32.
- Insights into Innovation, in *Proceedings of the Twenty-Seventh National Conference on the Administration of Research* (Denver: Denver Research Institute, 1974), 45-48.
- Creating More Effective R&D Plans for the Future, in *Business Challenges: An M.I.T. Perspective* (Cambridge: M.I.T. Industrial Liaison Program, 1976), 3-37.
- Technological Change and the Traditional Firm: Implications for Government Policy (with M. Sirbu, et al.) (M.I.T. Center for Policy Alternatives, CPA 77-II, May 1977); published in French, in Technologie et Avenir Regional (Paris: La Documentation Française, 1978), 193-229.
- Generating Effective Corporate Innovation, *Technology Review*, October/November 1977 (vol. 80, no. 1), 26-33.
- Strategies for Improving Research Utilization (with A. Frohman), *Technology Review*, March/April 1978 (vol. 80, no. 5), 32-39.
- Critical Functions: The Key to Managing Teamwork in the Innovation Process (with A. Fusfeld), in *Proceedings of the International Electronics Convention* (Boston: May 1978).
- Improving the Role of Technology Forecasting and Planning: How to Put Technology into Corporate Planning (with A. Fusfeld), in *Proceedings of the International Electronics Convention* (Boston: May 1978).
- A Correlation of R&D Laboratory Performance with Critical Functions Analysis (with R. Rhoades and A. Fusfeld), *R&D Management*, October 1978 (vol. 9, no. 1), 13-17.
- What Do We Really Know About Managing R&D? *Research Management*, November 1978 (vol. 21, no. 6), 6-11; reprinted with minor changes in *CHEMTECH*, March 1980 (vol. 10, no. 3), 156-160.
- Stimulating Technological Innovation: Organizational Approaches, *Research Management*, November 1979 (vol. 22, no. 6), 26-30.
- Critical Functions: Needed Roles in the Innovation Process (with A. Fusfeld), in R. Katz (editor), *Career Issues in Human Resource Management* (Englewood Cliffs, NJ: Prentice-Hall, Inc., 1981), 182-207.
- Staffing the Innovative Technology-Based Organization (with A.R. Fusfeld), *Sloan Management Review*, Spring 1981 (vol. 22, no. 3), 19-34; reprinted with changes in *CHEMTECH*, May 1983 (vol. 13, no. 5), 266-274.
- Biomedical Innovation: The Challenge and the Process (with J. Moskowitz, et al.), in E.B. Roberts, et al. (editors), *Biomedical Innovation* (Cambridge: The M.I.T. Press, 1981), 1-17.
- Influences on Innovation: Extrapolations to Biomedical Technology, in E.B. Roberts, et al. (editors), *Biomedical Innovation* (Cambridge: The M.I.T. Press, 1981), 50-74.
- The Development of Biomedical Technologies, in B.J. McNeil and E.G. Cravalho (editors), *Critical Issues in Medical Technology* (Boston: Auburn House, 1982), 3-22.
- Factors Affecting Research and Development Performance, in N.P. Suh and B.M. Kramer (editors), Cooperative Research

- (Washington, DC: National Science Foundation, 1982), 145-156.
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