

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)

S.M. M.I.T., 1960 (Management)

Ph.D. M.I.T., 1962 (Economics)

Website: <https://mitsloan.mit.edu/faculty/directory/edward-roberts>

Professional Experience

1958 Official M.I.T. Employment Date, as Full-Time Research Assistant to Professor Jay Forrester

1958-85 Co-Founding Member, M.I.T. System Dynamics Group

1959-61 Instructor, M.I.T. School of Industrial Management

1961 Consultant to the Administrator, James Webb, National Aeronautics and Space Administration

1961-65 Assistant Professor of Industrial Management, M.I.T.

1961-86 Member M.I.T. Alumni Council, various roles

1962-73 Co-Founding Member and Associate Director, NASA Organization Research Center #1, the MIT School of Industrial Management's first research center; internally titled as M.I.T. Research Program on the Management of Science and Technology; later 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, CEO and President, Pugh-Roberts Associates (Chairman from 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 Created 15.582, "Applications and Implementation of Industrial Dynamics", identified as the first "Action Learning" subject in the MIT Sloan School of Management

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-Space Marketing"

1966-70 National Council, The Institute of Management Sciences (TIMS)

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 (became Harvard-Vanguard Healthcare)

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

1970-74 Visiting Faculty Member, Centre d'Etude Industrielles, Geneva

1970- Professor of Management, M.I.T.

1971-74 Co-Founder, European Management Symposium (later becoming 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.T.-Boston Veterans Administration Hospital Joint Center on Health Care Management

1977-79 First study of an entire country's technology-based entrepreneurship (Israel)

1977-80 National Advisory Council, National Center for Health Care Technology at University of Missouri-Columbia

1977-83 Board of Governance, U.S. 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 (with 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

1985-93 Founder and Chair, Technion Entrepreneurial Associates (including creating the first programs in Israel on entrepreneurship and venture capital)

1986-87 U.S. National Research Council Task Force on the Management of Technology

1987-90 Visiting Faculty Member, Tefen School of Entrepreneurship (Israel), sponsored by Stef Wertheimer

1987-99 Founding Faculty Chairman (later Co-Chairman), M.I.T. Management of Technology (MOT) Program, MIT's first graduate joint degree program between the Schools of Engineering and Management

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

1990-95 Partner, PA Consulting Group, London

1990-2006 Co-Founder and Faculty Sponsor, "Birthing of Giants" Program: Jointly sponsored by MIT, Young Entrepreneurs Organization (YEO, now EO), and Inc. Magazine

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* (Oxford University Press, 1991)

1991-94;97- Founder and Chair, M.I.T. Entrepreneurship Center (renamed as the Martin Trust Center for M.I.T. Entrepreneurship, 2011)

1992 American Libraries Association Award for "Outstanding Academic Book of 1992" for *Entrepreneurs 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.S.-Israel Science & Technology Commission, U.S. Department of 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 named Internet Technologies China, Inc.), Beijing

1998-2002 Advisory Board, Corporate Board Resource Committee, The Boston Club

1998-2009 Co-Founder and Member, CommonAngels, first angel investment group in Greater Boston

1999-2006 Executive Committee, Technology Industry Group, Combined Jewish Philanthropies of Greater Boston

2000 Co-Founder, MIT Venture Mentoring Service (VMS)

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

2003-09 First study of an entire university's alumni entrepreneurs (MIT)

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

2005-08 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 Entrepreneurs of Tomorrow, Israel

2005- Founder and Faculty Director, M.I.T. Sloan Entrepreneurship & Innovation (E&I) MBA Track (co-Director, 2020-)

2006 Opening bell at NASDAQ to celebrate 10th anniversary of SOHU.com, with co-founder and CEO Charles Zhang

2006 International Center for Management of Engineering & Technology Award “For Distinguished Lifetime Contributions to the Field of Technology Management and Innovation”

2006-12 Board of Governors, Combined Jewish Philanthropies of Greater Boston

2007 “NASDAQ Center of Entrepreneurial Excellence Award” to MIT Entrepreneurship Center, from Global Consortium of Entrepreneurship Centers

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.T.-Portugal 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.T.-Skolkovo 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

2015-18 Advisory Board, Center for Surgery, Innovation & Bioengineering, Massachusetts General Hospital

2015- MIT Sponsor, Social Innovation Forum

2016 Chair, MIT Convocation on a Half-Century of Growing MIT Entrepreneurship

2016- Executive Committee, AIPAC Technology & Innovation Division

2017-2022 Board of Advisors, Maverick Ventures (Israel)

2017- Advisory Board, Martin Trust Center for MIT Entrepreneurship

2019 Received with Nancy Roberts the “Mayor Thomas M. Menino Memorial Award for Inspired Support of the Arts”

2020 Received “Legacy Award“ of the Global Consortium of Entrepreneurship Centers, “recognized for a lifetime of pioneering Entrepreneurship”

2021 Received with Nancy Roberts the “Leaders in Philanthropy Award” by the Association of Fundraising Professionals

2021 Named “PICMET Fellow” by Portland International Center for Management of Engineering and Technology

2021 Received Deshpande Foundation “Founder’s Award for lifelong contributions to entrepreneurship and innovation”

2021- Board, eForum.org (formerly MIT Enterprise Forum of Cambridge)

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

Service on MIT Committees: Admissions and Student Aid Committee, 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 Committee, 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-), Mindmesh (2021-), and non-profits North Country Chamber Players (2004-) and eForum.org (2021-). **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 (Beijing, formerly UCAN-TV) (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 (co-founder, 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, Affera, CeloLabs, Cover Wallet, Flagship Pioneering, HubSpot, Locu, Okta, 3Play Media, and Toast.

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 in Chinese, Tsinghua University Press, expected 2022).

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, 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; hardcover edition, World Scientific, 2022) (published in Chinese, Tsinghua University Press, expected 2022).

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 Concept in Corporate Management Education, in *Proceedings of the Sixth Annual Training Directors' Conference* (Flint, MI: General Motors Institute, 1966), 1.1-1.22.
 Systems Methodology for Evaluating Industrial Projects in the Context of National Strategies, in *Industrial Project Evaluation* (United Nations Centre for Industrial Development, October 1968).
 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 Fonctionnelle 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: (1) 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.

Publications on the Management of Technology, Innovation and Entrepreneurship

A. Dynamics of R&D Projects and Organizations

- 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

- 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'Avancement 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 Francaise, 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.
- A Summary Report on a Study of Industrial Innovation in Israel (with others), MIT Center for Policy Alternatives (CPA-79-19), August 1979.
- 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.
- R&D in the Context of the Whole Organization, in *Research and Development: Key Issues for Management* (New York: The Conference Board, 1983), 42-46.
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