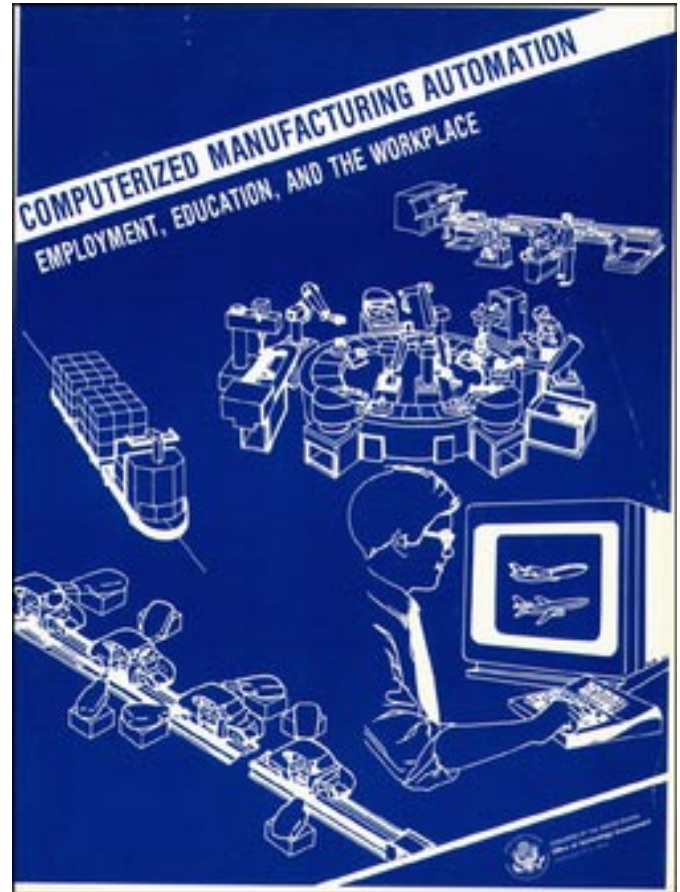


*Computerized Manufacturing Automation:
Employment, Education, and the Workplace*

April 1984

NTIS order #PB84-196500



Recommended Citation:

Computerized Manufacturing Automation: Employment, Education, and the Workplace (Washington, D. C.: U.S. Congress, Office of Technology Assessment, OTA-CIT-235, April 1984).

Library of Congress Catalog Card Number 84-601053

For sale by the Superintendent of Documents
U.S. Government Printing Office, Washington, D.C. 20402

Foreword

This assessment culminates OTA'S examination of the technical, economic, and social issues surrounding the spread of programmable automation in manufacturing. Its genesis was a public workshop in 1981 on robotics that resulted in the OTA Background Paper entitled *Exploratory Workshop on the Social Implications of Robotics* (February 1982). The assessment was requested by the Joint Economic Committee, the Senate Committee on Labor and Human Resources, the Senate Committee on Commerce, Science, and Transportation, and the Subcommittee on Labor Standards of the House Committee on Education and Labor. It was endorsed by the House Committee on Science and Technology. The assessment looks not only at robots but also at related computer-based technologies for design, production, and management.

The technologies of programmable automation, their uses, and future capabilities are described in this report. The assessment goes beyond technology description to characterize the industries producing and using programmable automation and to discuss the ramifications of the technologies for industrial structure and competitive conduct. It pays special attention to three labor-related areas: the potential for employment change, effects on the work environment, and implications for education and training. Preliminary work in those areas, including conceptual discussions and background material, was published in the OTA Technical Memorandum entitled *Automation and the Workplace: Selected Labor, Education, and Training Issues* (March 1983). Since the development and sale of programmable automation have been international phenomena since at least the 1960's, comparisons between this country and others are made as far as data allow.

A wide range of sources contributed to this assessment. While OTA drew on existing literature and conferences, it also developed its own information through workshops on labor markets, programmable automation technologies, and programmable automation (producer) industries; and through informal site visits and consultations. Eighteen case studies, including 4 on the work environment and 14 on education and training programs, and a survey of education and training activities commissioned for this assessment were particularly rich sources of data. Case study material will be made available in a companion volume.

OTA is grateful for the assistance of the assessment advisory panel, workshop participants, contractors, and many others who provided advice, information, and reviews. The cooperation of individuals at case study sites, who accommodated lengthy site visits and follow-up consultations, is especially appreciated. OTA assumes full responsibility for this assessment, which does not necessarily represent the views of individual members of the advisory panel.



JOHN H. GIBBONS
Director

Computerized Manufacturing Automation Advisory Panel

Roy Amara, Chairman
President, Institute for the Future

William D. Beeby
President
William Beeby & Associates, Inc.

Erich Bloch
Vice President, Technical Personnel
Development
IBM Corp.

Barbara A. Burns
Manufacturing Technology Group Engineer
Lockheed Georgia

Jack Cahall
Manager, Training and Development
Cincinnati Milacron, Inc.

Dennis Chamot
Assistant Director
Department of Professional Employees
AFL-CIO

Robert Cole
Director, Center for Japanese Studies
University of Michigan

Alan E. Drane
Manager of Automated Systems
Emhart Corp.

Audrey Freedman
Senior Research Associate
The Conference Board, Inc.

Sheldon Friedman
Director, Research Department
United Auto Workers

Theodore W. Kheel, Esq.
of Counsel
Battle, Fowler, Jaffin & Kheel

James F. Lardner
Vice President, Governmental Products and
Component Sales
Deere & Co.

Eli Lustgarten
Vice President
Paine Webber Mitchell Hutchins, Inc.

M. Granger Morgan
Professor, Engineering and Public Policy
Carnegie-Mellon University

George J. Poulin
General Vice President
International Association of Machinists and
Aerospace Workers

Bernard M. Sallot
President
Advanced Technologies Group Services

Harley Shaiken
Research Fellow
Massachusetts Institute of Technology

Kevin G. Snell
Director, Forward Planning and Program
Development
Career Works, Inc.

Alfred P. Taylor
Vice President (retired)
General Electric Co.

Philippe Villers
President
Automatix, Inc.

Victor C. Walling, Jr.
Coordinator, Business Futures Program
SRI International

Dennis Wisnosky
Vice President
GCA Corp.

Michael Wozny
Director, Center for Interactive Computer
Graphics
Rensselaer Polytechnic Institute

Robert Zager
Vice President, Policy Studies and Technical
Assistance
Work in America Institute

NOTE: OTA appreciates and is grateful for the valuable assistance and thoughtful critiques provided by these advisory panel members. The views expressed in this OTA Report, however, are the sole responsibility of the Office of Technology Assessment.

OTA Manufacturing Automation Assessment Staff

John Andelin, *Assistant Director, OTA
Science, Information, and Natural Resources Division*

Frederick W. Weingarten, *Communications and Information Technologies Program Manager*

Project Staff

Marjory S. Blumenthal, *Project Director**

Beth A. Brown, *Senior Analyst*

Jean E. Smith, *Analyst*

Jim Dray, *Research Assistant*

Beth Glassner, *Research Analyst*

Administrative Staff

Liz Emanuel Marsha Williams Shirley Gayheart

Contractors and Consultants

Eileen Appelbaum

N. Jeanne Argoff

Industry and Trade Strategies

Massachusetts Institute of Technology: Harley Shaiken, Sarah Kuhn, and Steve Herzenberg

WESTAT

Courtland S. Lewis (editor)

*Zalman A. Shaven served as Project Director from April to August 1982

Automation Technology Workshop

David Grossman
Manager of Automation Research
IBM Thomas J. Watson Research Center

Robert Hocken
Chief, Automated Production Technology
Division
National Bureau of Standards

Stuart G. Miller
Manager, Automation and Control Laboratory
Corporate Research and Development
General Electric Co.

Brian Moriarty
FMS Specialist
Charles Stark Draper Laboratories

Richard Mueller
Senior Consultant, CAD/CAM
Control Data Corp.

Michael Radeke
Vice President, Robotics
Cincinnati Milacron, Inc.

Bernard Roth
Design Division, Mechanical Engineering
Department
Stanford University

Ali Seireg
Department of Mechanical Engineering
University of Wisconsin-Madison

Richard Simon
Director, Product Management
CAM Systems
Computervision Corp.

Theodore J. Williams
Director, Laboratory for Applied Industrial
Control
Purdue University

Automation Industries Workshop

Kenneth Anderson
Publisher
Anderson Reports

Laura Conigliaro
Vice President
Prudential-Bache Securities, Inc.

Joseph Franklin
Statistical Director
National Machine Tool Builders Association

Eli Lustgarten
Vice President
Paine Webber Mitchell Hutchins, Inc.

Carl Machover
President
Machover Associates Corp.

Bernard M. Sallot
President
Advance Technologies Group Services

Dennis Wisnosky
Vice President
GCA Corp.

Labor Markets and Industrial Relations Workshop

Eileen Appelbaum
Department of Economics
Temple University

Steven Confer
Consultant
Communications Workers of America

William Cooke
Krannert School of Management
Purdue University

Faye Duchin
Institute for Economic Analysis
New York University

Alan Fechter
Executive Director
Office of Scientific and Engineering Personnel
National Research Council

Sheldon Friedman
Director, Research Department
United Auto Workers

Louis Jacobson
Center for Naval Analyses

Michael Pilot
Manager, Office of Occupational Outlook
Bureau of Labor Statistics

Markley Roberts
Economist
AFL-CIO

Myron Roomkin
Kellogg School of Management
Northwestern University

Jim Smith
Labor and Population Program
Rand Corp.

Reviewers and Other Contributors

Roger S. Albrandt, Jr.
Associate Director and Professor
School of Social Work
University of Pittsburgh

Robert Ayres
Professor, Engineering and Public Policy
Carnegie-Mellon University

Robert W. Bednarzik
Department of Labor
Bureau of International Labor Affairs

J. Terence Carleton
Analyst
Kidder, Peabody & Co., Inc.

Eileen Collins
Office of Policy, Research, and Analysis
National Science Foundation

Robert Craig
Vice President
American Society for Training and Development

Frank Curtin
General Manager, Factory Automation Systems
General Electric Co.

Edward Czarnecki
Associate Director
AFL-CIO Education Department

Kenneth R. Edwards
Director
Skill Improvement Training Department
International Brotherhood of Electrical Workers

Joel Fadem
Senior Fellow
Center for Quality of Working Life
University of California, Los Angeles

James Fleck
Lecturer
Technology Policy Unit
University of Aston (U. K.)

Barry Haimes
Analyst
Kidder, Peabody & Co., Inc.

David Hardt
Department of Mechanical Engineering
Massachusetts Institute of Technology

Eric Hendrix
International Affairs Analyst
Central Intelligence Agency

Daniel M. Hull
President
Center for Occupational Research and
Development

H. Allan Hunt
Manager for Research
The W. E. Upjohn Institute for Employment
Research

Timothy L. Hunt
Labor Economist
The W. E. Upjohn Institute for Employment
Research

G. Patrick Johnson
Division of Policy Research and Analysis
National Science Foundation

Ronald Larsen
Computer Science and Electronics Office
National Aeronautics and Space Administration

Lloyd Lehn
Assistant for Manufacturing Technology
Department of Defense

M. Eugene Merchant
Director, Advanced Manufacturing Research
Metcut Associates

Steven Miller
Graduate School of Industrial Administration
Carnegie-Mellon University

Randolph E. Ross
Analyst
Kidder, Peabody & Co., Inc.

Robert Schrank
Independent Consultant
(formerly with Ford Foundation)

Walter Schuelke
Manager, Sub-systems
Manufacturing Engineering
IBM- Poughkeepsie

Warren Seering
Department of Mechanical Engineering
Massachusetts Institute of Technology

Ben Shneiderman
Director, Human-Computer Interaction
Laboratory
University of Maryland

George Silvestri
Labor Economist
Bureau of Labor Statistics

Donald Vincent
Executive Director
Robot Institute of America

OTA Reviewers

John Alic
Eric Bazques
Linda Garcia
Martha Harris
Barry Holt
Donna Valtri
Fred Wood