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Automation has been employed for many years to provide a multitude of reasonably priced products for the American consumer. However, it has become evident that its real character as a manufacturing systems approach needs to be examined carefully for a better appreciation. In this book the purpose is to examine automation technology in its broadest sense and develop not only an understanding but also present some of the engineering and organization "know-how" by which manufacturing management can more effectively utilize automation to improve productivity and combat rising costs in the years ahead. Fundamentally, this book is addressed to manufacturing managers, and the material presented in a manner that will provide the knowledge for assuring success in automating. In addition, it highlights the manufacturing research and long-range planning that will be required for creating the new manufacturing technology so necessary for assuring success in future automation efforts. One of the important facts emphasized in this text is that automation is not merely robotics or another kind or type of machinery. To effect true productivity improvement requires a fresh look at the entire production process or facility-as a completely integrated system. With the developments of the past few years, rapid advances in the technology and the "tools of automation" have brought this imperative goal within the reasonable grasp of manufacturing management in almost every segment of industry. However, to utilize this progress, it is necessary to acquire a working understanding of all facets of automation.

This book provides an extended overview and fundamental knowledge in industrial automation, while building the necessary knowledge level for further specialization in advanced concepts of industrial automation. It covers a number of central concepts of industrial automation, such as basic automation elements, hardware components for automation and process control, the latch principle, industrial automation synthesis, logical design for automation, electropneumatic automation, industrial networks, basic programming in PLC, and PID in the industry.

Automation, Production Systems, and Computer-Integrated Manufacturing is appropriate for advanced undergraduate/ graduate-level courses in Automation, Production Systems, and Computer-Integrated Manufacturing. This exploration of the technical and engineering aspects of automated production systems provides the most advanced, comprehensive, and balanced cover-

age of the subject of any text on the market. It covers all the major cutting-edge technologies of production automation and material handling, and how these technologies are used to construct modern manufacturing systems. This book will provide a better teaching and learning experience—for you and your students. It will help: Provide Balanced Coverage of Automated Production Systems: A quantitative approach provides numerous equations and example problems for instructors who want to include analytical and quantitative material in their courses. Support Learning: End-of-chapter problems, review questions, and problem exercises give students plenty of opportunities to put theory into action. Keep Your Course Current: This edition provides up-to-date coverage of production systems, how they are sometimes automated and computerised, and how they can be mathematically analysed to obtain performance metrics. The full text downloaded to your computer With eBooks you can: search for key concepts, words and phrases make highlights and notes as you study share your notes with friends eBooks are downloaded to your computer and accessible either offline through the Bookshelf (available as a free download), available online and also via the iPad and Android apps. Upon purchase, you'll gain instant access to this eBook. Time limit The eBooks products do not have an expiry date. You will continue to access your digital ebook products whilst you have your Bookshelf installed.

This second edition of the classic textbook has been written to provide a completely up-to-date text for students of mechanical, industrial, manufacturing and production engineering, and is an indispensable reference for professional industrial engineers and managers. In his outstanding book, Professor Katsundo Hitomi integrates three key themes into the text: \* manufacturing technology \* production management \* industrial economics Manufacturing technology is concerned with the flow of materials from the acquisition of raw materials, through conversion in the workshop to the shipping of finished goods to the customer. Production management deals with the flow of information, by which the flow of materials is managed efficiently, through planning and control techniques. Industrial economics focuses on the flow of production costs, aiming to minimise these to facilitate competitive pricing. Professor Hitomi argues that the fundamental purpose of manufacturing is to create tangible goods, and it has a tradition dating back to the prehistoric toolmakers. The fundamental importance of manufacturing is that it facilitates basic existence, it creates wealth, and it contributes to human happiness - manufactur-

ing matters. Nowadays we regard manufacturing as operating in these other contexts, beyond the technological. It is in this unique synthesis that Professor Hitomi's study constitutes a new discipline: manufacturing systems engineering - a system that will promote manufacturing excellence. Key Features: \* The classic textbook in manufacturing engineering \* Fully revised edition providing a modern introduction to manufacturing technology, production management and industrial economics \* Includes review questions and problems for the student reader

The International Conference on Intelligent Computing (ICIC) was formed to provide an annual forum dedicated to the emerging and challenging topics in artificial intelligence, machine learning, pattern recognition, image processing, bioinformatics, and computational biology. It aims to bring together researchers and practitioners from both academia and industry to share ideas, problems, and solutions related to the multifaceted aspects of intelligent computing. ICIC 2010, held in Changsha, China, August 18-21, 2010, constituted the 6th International Conference on Intelligent Computing. It built upon the success of ICIC 2009, ICIC 2008, ICIC 2007, ICIC 2006, and ICIC 2005, that were held in Ulsan, Korea, Shanghai, Qingdao, Kunming and Hefei, China, respectively. This year, the conference concentrated mainly on the theories and methodologies as well as the emerging applications of intelligent computing. Its aim was to unify the picture of contemporary intelligent computing techniques as an integral concept that highlights the trends in advanced computational intelligence and bridges theoretical research with applications. Therefore, the theme for this conference was "Advanced Intelligent Computing Technology and Applications." Papers focusing on this theme were solicited, addressing theories, methodologies, and applications in science and technology.

The purpose of this book is to present an introduction to the multidisciplinary field of automation and robotics for industrial applications. The companion files include numerous video tutorial projects and a chapter on the history and modern applications of robotics. The book initially covers the important concepts of hydraulics and pneumatics and how they are used for automation in an industrial setting. It then moves to a discussion of circuits and using them in hydraulic, pneumatic, and fluidic design. The latter part of the book deals with electric and electronic controls in automation and final chapters are devoted to robotics, robotic programming, and applications of robotics in industry. eBook Customers: Companion files are available for downloading with order number/proof of purchase by writing to the publisher at [info@merclearning.com](mailto:info@merclearning.com). Features: \* Begins with introductory concepts on automation, hydraulics, and pneumatics \* Covers sensors, PLC's, microprocessors, transfer devices and feeders, robotic sensors, robotic grippers, and robot programming

Divided into two major areas of discussion - work systems, and work methods, measurement, and management - this guide provides up-to-date, quantitative coverage of work systems and how work is analyzed and designed. Includes 30 chapters organized into six parts: Work Systems and How They Work; Methods Engineering and Layout Planning; Time Study and Work Measurement; New Approaches in Process Improvement and Work Management; Ergonomics and Human Factors in the Workplace, and Traditional Topics in Work Management. Addresses the "systems" by which work is accomplished, such as worker-machine systems, manufacturing cells, assembly lines, projects, and office work pools. Summarizes many aspects of work systems, operations analysis, and work measurement using mathematical equations and quantitative examples. For professionals in the area of industrial engineering.

This exploration of the technical and engineering aspects of auto-

mated production systems provides a comprehensive and balanced coverage of the subject. It covers cutting-edge technologies of production automation and material handling, and how these technologies are used to construct modern manufacturing systems.

The Technology Of Cad/Cam/Cim Deals With The Creation Of Information At Different Stages From Design To Marketing And Integration Of Information And Its Effective Communication Among The Various Activities Like Design, Product Data Management, Process Planning, Production Planning And Control, Manufacturing, Inspection, Materials Handling Etc., Which Are Individually Carried Out Through Computer Software. Seamless Transfer Of Information From One Application To Another Is What Is Aimed At. This Book Gives A Detailed Account Of The Various Technologies Which Form Computer Based Automation Of Manufacturing Activities. The Issues Pertaining To Geometric Model Creation, Standardisation Of graphics Data, Communication, Manufacturing Information Creation And Manufacturing Control Have Been Adequately Dealt With. Principles Of Concurrent Engineering Have Been Explained And Latest Software In The Various Application Areas Have Been Introduced. The Book Is Written With Two Objectives To Serve As A Textbook For Students Studying Cad/Cam/Cim And As A Reference Book For Professional Engineers.

Comprehensive, detailed, and organized for speedy reference--everything you need to know about modern manufacturing technology. From concurrent engineering to fixture design for machining systems, from robotics and artificial intelligence to facility layout planning and automated CAD-based inspection, this handbook provides all the information you need to design, plan, and implement a modern, efficient manufacturing system tailored to your company's special needs and requirements. Handbook of Design, Manufacturing and Automation does more than simply present the characteristics and specifications of each technology--much more. Each technology is discussed both in terms of its own capabilities and in terms of its compatibility with other technologies, and the trade-offs involved in choosing one option over another are explored at length. An entire section is devoted to the business aspects of converting to the new technologies, including acquisition of automation, managing advanced manufacturing technology, and issues of cost and financing. The focus is on incorporating these technologies into a cohesive whole--an efficient, cost-effective manufacturing system. Other important topics include: \* Design for automated manufacturing \* Nontraditional manufacturing processes \* Machine tool programming techniques and trends \* Precision engineering and micromanufacturing \* Computer-integrated product planning and control \* Image processing for manufacturing \* And much more

This study explores the following question: Does a worker's relationship to technology and degree of job specialization influence in a predictable way his integration into or alienation from work? The book shows that the degree of differentiation in the division of labor is related to technology in a similar manner in both the office and factory and that automated technology reduces the levels of alienation among both office employees and factory workers. The author samples three man-machine relationships in the office and factory: (1) workers in non-mechanized production systems; (2) machine operators in mechanized production systems; and (3) operators or monitors in automated production systems. In addition to separate chapters on office and factory workers, one chapter compares degrees and types of alienation among office employees as compared to factory workers. This book is one of the last in a series of research studies on the impact of computers completed by the Industrial Relations Section of the Alfred P. Sloan School of Management at M.I.T. In a foreword to the

book, Charles A. Myers notes that "this important study puts to rest extreme fears about the alienation of workers as a consequence of automation. Professor Shepard's study provides new insights about the impact of advanced mechanization and automation in offices, which computers and allied information technology are invading at a rapid rate...As a sociologist among economists, [he] has brought fresh perspective to this series of research reports."

Production and manufacturing management since the 1980s has absorbed in rapid succession several new production management concepts: manufacturing strategy, focused factory, just-in-time manufacturing, concurrent engineering, total quality management, supply chain management, flexible manufacturing systems, lean production, mass customization, and more. With the increasing globalization of manufacturing, the field will continue to expand. This encyclopedia's audience includes anyone concerned with manufacturing techniques, methods, and manufacturing decisions.

From concept development to final production, this comprehensive text thoroughly examines the design, prototyping, and fabrication of engineering products and emphasizes modern developments in system modeling, analysis, and automatic control. This reference details various management strategies, design methodologies, traditional production techniques

Intelligent systems are required to facilitate the use of information provided by the internet and other computer based technologies. This book describes the state-of-the-art in Intelligent Automation and Systems Engineering. Topics covered include Intelligent decision making, Automation, Robotics, Expert systems, Fuzzy systems, Knowledge-based systems, Knowledge extraction, Large database management, Data analysis tools, Computational biology, Optimization algorithms, Experimental designs, Complex system identification, Computational modeling, Systems simulation, Decision modeling, and industrial applications.

World-renowned economist Klaus Schwab, Founder and Executive Chairman of the World Economic Forum, explains that we have an opportunity to shape the fourth industrial revolution, which will fundamentally alter how we live and work. Schwab argues that this revolution is different in scale, scope and complexity from any that have come before. Characterized by a range of new technologies that are fusing the physical, digital and biological worlds, the developments are affecting all disciplines, economies, industries and governments, and even challenging ideas about what it means to be human. Artificial intelligence is already all around us, from supercomputers, drones and virtual assistants to 3D printing, DNA sequencing, smart thermostats, wearable sensors and microchips smaller than a grain of sand. But this is just the beginning: nanomaterials 200 times stronger than steel and a million times thinner than a strand of hair and the first transplant of a 3D printed liver are already in development. Imagine "smart factories" in which global systems of manufacturing are coordinated virtually, or implantable mobile phones made of biosynthetic materials. The fourth industrial revolution, says Schwab, is more significant, and its ramifications more profound, than in any prior period of human history. He outlines the key technologies driving this revolution and discusses the major impacts expected on government, business, civil society and individuals. Schwab also offers bold ideas on how to harness these changes and shape a better future—one in which technology empowers people rather than replaces them; progress serves society rather than disrupts it; and in which innovators respect moral and ethical boundaries rather than cross them. We all have the opportunity to contribute to developing new frameworks that advance progress.

An in depth examination of manufacturing control systems using structured design methods. Topics include ladder logic and other IEC 61131 standards, wiring, communication, analog IO, structured programming, and communications. Allen Bradley PLCs are used extensively through the book, but the formal design methods are applicable to most other PLC brands. A full version of the book and other materials are available on-line at <http://engineeronadisk.com>

As a consultant, Kiyoshi Suzuki has helped scores of Fortune 500 clients improve manufacturing operations and get the job done faster, cheaper, better, and safer. Now, in this detailed "operating manual" -- full of more step-by-step applications than any other book available -- Suzuki spells out new options in production and employee resources that can help American industry regain the cutting edge in price, quality, and delivery of products. A well-known expert in the field, Suzuki begins with the premise that "if it doesn't add value, it's waste" -- a concept devised by Henry Ford and later used by Toyota. He recaps what Toyota identifies as the seven most prominent forms of waste in factories. Most importantly, he meticulously details steps individuals can take to "simplify, combine, and eliminate operations" -- thereby reducing waste, improving quality, and saving money. Describing in detail the basic techniques culled from Japanese industrial philosophy and procedure, Suzuki shows how small, family-run businesses and billion-dollar American corporations from a wide range of industries -- automotive, electronics, cosmetics, and even defense contractors -- are meeting the manufacturing challenge today -- demolishing the widely held belief that most American manufacturers have become distribution organizations for products manufactured overseas. In addition, he links his methodology with several successful production systems, from Just-In-Time Production, Total Quality Control, Total Productive Maintenance to Computer Integrated Manufacturing. Throughout this practical handbook, he places emphasis squarely on the shop floor and grounds his approach in easy, yet powerful techniques everybody can understand and implement today. Illustrated with numerous charts and exhibits, *The New Manufacturing Challenge* shows how to integrate people and techniques to improve the workplace and, thus, strengthen any company's competitiveness in the global marketplace.

Automation is the technology that is designed to function without human assistance. Various control systems are used for the operation of equipment used in factories, boilers, ships, aircraft, etc. Automation is achieved by integrating hydraulic, electrical, mechanical, pneumatic and electronic devices and computers. It results in labor, electricity cost and material cost saving. It also ensures improvement of quality, precision and accuracy. Computer-integrated manufacturing is the approach to the use of computers for controlling the production process. It allows the exchange of information between processes. It is used in multiple domains, such as in mechanical engineering, electronic design automation, industrial and production engineering, etc. This book unfolds the innovative aspects of automation, production systems and computer-integrated manufacturing which will be crucial for the holistic understanding of modern manufacturing. Most of the topics introduced herein cover new techniques and the applications of these processes. As this field is emerging at a rapid pace, the contents of this book will help the readers understand the modern concepts and applications of the subjects.

Towards Balanced Automation The concept. Manufacturing industries worldwide are facing tough challenges as a consequence of the globalization of economy and the openness of the markets. Progress of the economic blocks such as the European Union, NAFTA, and MERCOSUR, and the global agreements such as GATT, in

addition to their obvious economic and social consequences, provoke strong paradigm shifts in the way that the manufacturing systems are conceived and operate. To increase profitability and reduce the manufacturing costs, there is a recent tendency towards establishing partnership links among the involved industries, usually between big industries and the networks of components' suppliers. To benefit from the advances in technology, similar agreements are being established between industries and universities and research institutes. Such an open tete-cooperation network may be identified as an extended enterprise or a virtual enterprise. In fact, the manufacturing process is no more carried out by a single enterprise, rather each enterprise is just a node that adds some value (a step in the manufacturing chain) to the cooperation network of enterprises. The new trends create new scenarios and technological challenges, especially to the Small and Medium size Enterprises (SMEs) that clearly comprise the overwhelming majority of manufacturing enterprises worldwide. Under the classical scenarios, these SMEs would have had big difficulties to access or benefit from the state of the art technology, due to their limited human, financial, and material resources. A practical guide to industrial automation concepts, terminology, and applications *Industrial Automation: Hands-On* is a single source of essential information for those involved in the design and use of automated machinery. The book emphasizes control systems and offers full coverage of other relevant topics, including machine building, mechanical engineering and devices, manufacturing business systems, and job functions in an industrial environment. Detailed charts and tables serve as handy design aids. This is an invaluable reference for novices and seasoned automation professionals alike. **COVERAGE INCLUDES:** \* Automation and manufacturing \* Key concepts used in automation, controls, machinery design, and documentation \* Components and hardware \* Machine systems \* Process systems and automated machinery \* Software \* Occupations and trades \* Industrial and factory business systems, including Lean manufacturing \* Machine and system design \* Applications

The second edition of this best-selling Python book (over 500,000 copies sold!) uses Python 3 to teach even the technically uninclined how to write programs that do in minutes what would take hours to do by hand. There is no prior programming experience required and the book is loved by liberal arts majors and geeks alike. If you've ever spent hours renaming files or updating hundreds of spreadsheet cells, you know how tedious tasks like these can be. But what if you could have your computer do them for you? In this fully revised second edition of the best-selling classic *Automate the Boring Stuff with Python*, you'll learn how to use Python to write programs that do in minutes what would take you hours to do by hand--no prior programming experience required. You'll learn the basics of Python and explore Python's rich library of modules for performing specific tasks, like scraping data off websites, reading PDF and Word documents, and automating clicking and typing tasks. The second edition of this international fan favorite includes a brand-new chapter on input validation, as well as tutorials on automating Gmail and Google Sheets, plus tips on automatically updating CSV files. You'll learn how to create programs that effortlessly perform useful feats of automation to:

- Search for text in a file or across multiple files
- Create, update, move, and rename files and folders
- Search the Web and download online content
- Update and format data in Excel spreadsheets of any size
- Split, merge, watermark, and encrypt PDFs
- Send email responses and text notifications
- Fill out online forms

Step-by-step instructions walk you through each program, and updated practice projects at the end of each chapter challenge you to improve those programs and use your newfound

skills to automate similar tasks. Don't spend your time doing work a well-trained monkey could do. Even if you've never written a line of code, you can make your computer do the grunt work. Learn how in *Automate the Boring Stuff with Python*, 2nd Edition. This book discusses challenges and solutions for the required information processing and management within the context of multi-disciplinary engineering of production systems. The authors consider methods, architectures, and technologies applicable in use cases according to the viewpoints of product engineering and production system engineering, and regarding the triangle of (1) product to be produced by a (2) production process executed on (3) a production system resource. With this book industrial production systems engineering researchers will get a better understanding of the challenges and requirements of multi-disciplinary engineering that will guide them in future research and development activities. Engineers and managers from engineering domains will be able to get a better understanding of the benefits and limitations of applicable methods, architectures, and technologies for selected use cases. IT researchers will be enabled to identify research issues related to the development of new methods, architectures, and technologies for multi-disciplinary engineering, pushing forward the current state of the art.

Collaborative design has attracted much attention in the research community in recent years. With increasingly decentralized manufacturing systems and processes, more collaborative approaches and systems are needed to support distributed manufacturing operations. "Collaborative Design and Planning for Digital Manufacturing" presents a focused collection of quality chapters on the state-of-the-art research efforts in the area of collaborative design and planning, as well as their practical applications towards digital manufacturing. "Collaborative Design and Planning for Digital Manufacturing" provides both a broad-based review of the key areas of research in digital manufacturing, and an in-depth treatment of particular methodologies and systems, from collaborative design to distributed planning, monitoring and control. Recent development and innovations in this area provide a pool of focused research efforts, relevant to a wide readership from academic researchers to practicing engineers.

Group Technology and Cellular Manufacturing (GT/CM) have been widely-researched areas in the past 15 years and much progress has been made in all branches of GT/CM. Resulting from this research activity has been a proliferation of techniques for part-machine grouping, engineering data bases, expert system-based design methods for identifying part families, new analytical and simulation tools for evaluating performance of cells, new types of cell incorporating robotics and flexible automation, team-based approaches for organizing the work force and much more; however, the field lacks a careful compilation of this research and its outcomes. The editors of this book have commissioned leading researchers and implementers to prepare specific treatments of topics for their special areas of expertise in this broad-based philosophy of manufacturing. The editors have sought to be global both in coverage of topic matters and contributors. Group Technology and Cellular Manufacturing addresses the needs and interests of three groups of individuals in the manufacturing field: academic researchers, industry practitioners, and students. (1) The book provides an up-to-date perspective, incorporating the advances made in GT/CM during the past 15 years. As a natural extension to this research, it synthesizes the latest industry practices and outcomes to guide research to greater real-world relevance. (2) The book makes clear the foundations of GT/CM from the core elements of new developments which are aimed at reducing developmental and manufacturing lead times, costs, and at improving business quality and performance. (3) Finally, the book can be used as a textbook for graduate students in engineering and man-

agement for studying the field of Group Technology and Cellular Manufacturing.

Metal cutting is widely used in producing manufactured products. The technology has advanced considerably along with new materials, computers and sensors. This new edition considers the scientific principles of metal cutting and their practical application to manufacturing problems. It begins with metal cutting mechanics, principles of vibration and experimental modal analysis applied to solving shop floor problems. There is in-depth coverage of chatter vibrations, a problem experienced daily by manufacturing engineers. Programming, design and automation of CNC (computer numerical control) machine tools, NC (numerical control) programming and CAD/CAM technology are discussed. The text also covers the selection of drive actuators, feedback sensors, modelling and control of feed drives, the design of real time trajectory generation and interpolation algorithms and CNC-oriented error analysis in detail. Each chapter includes examples drawn from industry, design projects and homework problems. This is ideal for advanced undergraduate and graduate students and also practising engineers.

Never HIGHLIGHT a Book Again! Virtually all of the testable terms, concepts, persons, places, and events from the textbook are included. Cram101 Just the FACTS101 studyguides give all of the outlines, highlights, notes, and quizzes for your textbook with optional online comprehensive practice tests. Only Cram101 is Textbook Specific. Accompanys: 9780132393218 .

Mikell Groover, author of the leading text in manufacturing processes, has developed Introduction to Manufacturing Processes as a more navigable and student-friendly text paired with a strong suite of additional tools and resources online to help instructors drive positive student outcomes. Focusing mainly on processes, tailoring down the typical coverage of both materials and systems. The emphasis on manufacturing science and mathematical modeling of processes is an important attribute of the new book. Real world/design case studies are also integrated with fundamentals - process videos provide students with a chance to experience being 'on the floor' in a manufacturing facility, followed by case studies that provide individual students or groups of students to dig into larger/more design-oriented problems.

This project-oriented facilities design and material handling reference explores the techniques and procedures for developing an efficient facility layout, and introduces some of the state-of-the-art tools involved, such as computer simulation. A "how-to," systematic, and methodical approach leads readers through the collection, analysis and development of information to produce a quality functional plant layout. Lean manufacturing; work cells and group technology; time standards; the concepts behind calculating machine and personnel requirements, balancing assembly lines, and leveling workloads in manufacturing cells; automatic identification and data collection; and ergonomics. For facilities planners, plant layout, and industrial engineer professionals who are involved in facilities planning and design.

Automation, Production Systems, and Computer-Integrated Manufacturing is appropriate for advanced undergraduate/ graduate-level courses in Automation, Production Systems, and Computer-Integrated Manufacturing. This exploration of the technical and engineering aspects of automated production systems pro-

vides the most advanced, comprehensive, and balanced coverage of the subject of any text on the market. It covers all the major cutting-edge technologies of production automation and material handling, and how these technologies are used to construct modern manufacturing systems. Teach.

Automation, Production Systems, and Computer-Integrated Manufacturing is appropriate for advanced undergraduate/ graduate-level courses in Automation, Production Systems, and Computer-Integrated Manufacturing. This exploration of the technical and engineering aspects of automated production systems provides the most advanced, comprehensive, and balanced coverage of the subject of any text on the market. It covers all the major cutting-edge technologies of production automation and material handling, and how these technologies are used to construct modern manufacturing systems. Teaching and Learning Experience This book will provide a better teaching and learning experience-for you and your students. It will help: \*Provide Balanced Coverage of Automated Production Systems: A quantitative approach provides numerous equations and example problems for instructors who want to include analytical and quantitative material in their courses. \*Support Learning: End-of-chapter problems, review questions, and problem exercises give students plenty of opportunities to put theory into action.\*Keep Your Course Current: This edition provides up-to-date coverage of production systems, how they are sometimes automated and computerized, and how they can be mathematically analyzed to obtain performance metrics.

Focusing on the design and implementation of computer-based automatic machine tools, David F. Noble challenges the idea that technology has a life of its own. Technology has been both a convenient scapegoat and a universal solution, serving to disarm critics, divert attention, depoliticize debate, and dismiss discussion of the fundamental antagonisms and inequalities that continue to beset America. This provocative study of the postwar automation of the American metal-working industry—the heart of a modern industrial economy—explains how dominant institutions like the great corporations, the universities, and the military, along with the ideology of modern engineering shape, the development of technology. Noble shows how the system of "numerical control," perfected at the Massachusetts Institute of Technology (MIT) and put into general industrial use, was chosen over competing systems for reasons other than the technical and economic superiority typically advanced by its promoters. Numerical control took shape at an MIT laboratory rather than in a manufacturing setting, and a market for the new technology was created, not by cost-minded producers, but instead by the U. S. Air Force. Competing methods, equally promising, were rejected because they left control of production in the hands of skilled workers, rather than in those of management or programmers. Noble demonstrates that engineering design is influenced by political, economic, managerial, and sociological considerations, while the deployment of equipment—illustrated by a detailed case history of a large General Electric plant in Massachusetts—can become entangled with such matters as labor classification, shop organization, managerial responsibility, and patterns of authority. In its examination of technology as a human, social process, Forces of Production is a path-breaking contribution to the understanding of this phenomenon in American society.