

**ENCYCLOPEDIA OF PRODUCTION  
AND MANUFACTURING  
MANAGEMENT**

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PRODUCTION AND MANUFACTURING MANAGEMENT**

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# ENCYCLOPEDIA OF PRODUCTION AND MANUFACTURING MANAGEMENT

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*Printed on acid-free paper.*

Printed in the United States of America

To my parents:  
Jacob M. and Gnanam Swamidass



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- U-Shaped Assembly Lines, *Gerald Aase, Northern Illinois University, USA; Robert F. Jacobs, Indiana University, USA.*
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Gregory P. White, *Southern Illinois University—Carbondale.*  
Richard E. White, *University of North Texas.*  
James M. Wilson, *Glasgow Business School, UK.*
- Enver Yücesan, *INSEAD, France.*

## Manufacturers and Organizations Discussed in the Encyclopedia

One of the special features of this encyclopedia is that it gives several real life examples from manufacturing firms from around the world. The list below contains over 100 manufacturers, from the U.S., Japan, Europe, Korea and other nations. In addition, it includes trucking and transportation companies and leading retailers, who are used as examples in various articles. Some manufacturers such as Chrysler, GM, IBM, Motorola, and Toyota are discussed in several articles.

Manufacturers and organizations are listed on the left column. The articles in which the organization is mentioned are listed in the right column.

Organization	Article where discussed
<b>3M</b>	Environmental issues and operations mgmt. JIT evolution and use in the United States New product development through. . .
<b>ABB Group</b>	Environmental issues and operations mgmt.
<b>ADAC Laboratories</b>	Performance excellence: The Malcolm. . .
<b>Aerotech Services Corporation</b>	Virtual manufacturing
<b>AIAG</b>	JIT evolution and use in the United States
<b>Albany International</b>	Just-in-time manufacturing implications
<b>Allegheny Ludlum Corporation</b>	Core manufacturing competencies
<b>Allen Edmonds Shoe Corporation</b>	Supplier performance measurement
<b>Allen-Bradley</b>	Core manufacturing competencies and. . .
<b>Allied-Signal</b>	Purchasing: Acquiring the best inputs
<b>Amdahl</b>	Supplier partnership as strategy
<b>Anderson Windows</b>	Mass customization and manufacturing
<b>Anheuser-Busch</b>	Facilities location decision
<b>ANSI</b>	Electronic data interchange in supply chain ISO 9000/QS 9000 quality standards
<b>Apple</b>	Supplier partnership as strategy
<b>Applied Materials, Inc.</b>	Virtual manufacturing
<b>Applied Services Corporation</b>	Virtual manufacturing
<b>Army Ordnance</b>	Quality: The implications of Deming's. . .
<b>ASA</b>	Quality: The implications of Deming's. . .
<b>ASME</b>	Quality: The implications of Deming's. . .
<b>ASQC, ASQ</b>	ISO 9000/QS 9000 quality standards
<b>ASTM</b>	Quality: The implications of Deming's. . .

Organization	Article where discussed
<b>AT&amp;T</b>	Agile manufacturing
<b>Auto Air</b>	Environmental issues: Reuse and recycling
<b>AVO, Inc.</b>	Supplier performance measurement
<b>B.F. Goodrich</b>	Virtual manufacturing
<b>BAAN</b>	Facilities location decision
<b>Bally Engineered Structures</b>	Enterprise resource planning (ERP)
<b>Bausch &amp; Lomb</b>	MRP implementation
<b>Bechtel</b>	Agile manufacturing
<b>Ben &amp; Jerry's Ice Cream</b>	Mass customization
<b>Bennetton</b>	Product design for global markets
<b>Black and Decker</b>	Mass customization and manufacturing
<b>BMW</b>	Balanced scorecard
<b>Boeing</b>	Agile Logistics
<b>Bose Corporation</b>	Logistics: Meeting customer's real needs
<b>Boston Consulting Group</b>	Supplier partnership as strategy
<b>Briggs and Stratton</b>	Electronic data interchange in supply chain
<b>Bristol-Myers Squibb</b>	JIT evolution and use in the United States
<b>British Airways</b>	Mass customization and manufacturing
<b>Burlington</b>	Environmental issues and operations mgmt.
<b>CAM-I</b>	Learning curve analysis
<b>Camtronics Medical Systems</b>	Manufacturing flexibility
<b>Carolina Freight</b>	Product design for global markets
<b>Caterpillar</b>	Supplier performance measurement
<b>CERES</b>	Purchasing: The future
<b>Chrysler</b>	Learning curve analysis
	Quality: The implications of Deming's...
	Bullwhip effect in supply chain
	Environmental issues and operations mgmt.
	Bullwhip effect in supply chain
	Activity-based costing: An evaluation
	Capital investment in advanced technology
	New product development through...
	Cost analysis for purchasing
	Electronic data interchange in supply chain
	Logistics: Meeting customer's real needs
	Total quality management
	Environmental issues and operations mgmt.
	Agile manufacturing
	Concurrent engineering
	Electronic data interchange in supply chain
	Facilities location decision
	New product development through...
	Outsourcing of product design...



Organization	Article where discussed
	Product innovation
	Purchasing: Acquiring the best inputs
	Quality management systems: Baldrige...
	Supplier performance measurement
	Supplier relationships
	Virtual manufacturing
<b>Coca-Cola</b>	Mass customization and manufacturing
	Product design for global markets
<b>Colgate</b>	Product design for global markets
<b>Compaq</b>	Agile Logistics
	Human resource issues in manufacturing
	Mass customization and manufacturing
	Electronic data interchange in supply chain
<b>Consolidated Freightways</b>	Focused factory
<b>Copeland Corporation</b>	Logistics: Meeting customer's real needs
<b>Council of Logistics Management</b>	Virtual manufacturing
<b>C-TAD systems</b>	Concurrent engineering
<b>Cummins Engine</b>	Learning curve analysis
<b>Curtis-Wright Corporation</b>	Mass customization: Implementation
<b>Custom Clothing Technology</b>	Performance excellence: The Malcolm...
<b>Custom Research Inc. (CRI)</b>	Global manufacturing rationalization
<b>Daewoo (Korea)</b>	JIT evolution and use in the United States
<b>Daihatsu Motors</b>	Target costing
	Environmental issues and operations mgmt.
<b>Daimler-Benz</b>	Performance excellence: The Malcolm...
<b>Dana Commercial Credit</b>	Total quality management
<b>Dana Corporation</b>	Virtual manufacturing
<b>DARPA</b>	Agile Logistics
<b>Dell</b>	Bullwhip effect in supply chain
	Supplier partnership as strategy
<b>Digital Equipment Corporation</b>	Virtual manufacturing
<b>DMSO</b>	New product development through...
<b>Dodge</b>	History of manufacturing management
<b>Du Pont</b>	ISO 9000/QS 9000 quality standards
	Just-in-time manufacturing: Implications
	Total productive maintenance
<b>Dun and Bradstreet</b>	Purchasing: Acquiring the best inputs
<b>Electro</b>	Customer service, satisfaction and success
<b>Eli-Lilly</b>	Bullwhip effect in supply chain
	Environmental issues and operations mgmt.
<b>Exxon</b>	Facilities location decision
<b>Federal Express</b>	Agile Logistics
<b>Fisher Technology</b>	Purchasing: The future

Organization	Article where discussed
<b>Florist Telegraph Service (FTD)</b>	Agile Logistics
<b>Ford</b>	Agile manufacturing Assembly line design Concurrent engineering Electronic data interchange in supply chain Facilities location decision History of manufacturing management ISO 9000/QS 9000 quality standards Purchasing: Acquiring the best inputs Quality management systems: Baldrige... Quality: The implications of Deming's... Reengineering and the process view of... Statistical process control using control... Supplier performance measurement Total quality management U-shaped assembly lines Virtual manufacturing
<b>Ford-VW</b>	Outsourcing of product design...
<b>Freightliner</b>	ISO 9000/QS 9000 quality standards
<b>Fuji</b>	New product development through...
<b>Fuji-Xerox</b>	Product design for global markets
<b>GAAP</b>	Accounting system implications of TOC Activity-based costing
<b>Gateway</b>	Agile Logistics
<b>GE</b>	Facilities location decision JIT evolution and use in the United States Mass customization and manufacturing Purchasing: The future Total productive maintenance Total quality management
<b>GE Fanuc</b>	Agile manufacturing Mass customization and manufacturing
<b>General Foods</b>	Facilities location decision
<b>Gillette</b>	Mass customization and manufacturing
<b>GM</b>	Agile manufacturing Concurrent engineering Core manufacturing competencies Core manufacturing competencies and... Facilities location decision Global manufacturing rationalization Human resource issues in manufacturing ISO 9000/QS 9000 quality standards Logistics: Meeting customer's real needs

Organization	Article where discussed
	Manufacturing flexibility dimensions
	Manufacturing strategy
	Mass customization
	Quality management systems: Baldrige...
	Supplier partnership as strategy
	Supplier performance measurement
	Total quality management
	Virtual manufacturing
<b>Graphic Enterprises</b>	Quality: The implications of Deming's...
<b>Harley-Davidson</b>	Just-in-time manufacturing
<b>Heineken</b>	Product design for global markets
<b>Heinz</b>	Facilities location decision
<b>Hermann Miller</b>	Environmental issues and operations mgmt.
<b>Hershey</b>	Customer service, satisfaction and success
<b>Hewlett Packard</b>	Product design for global markets
	Concurrent engineering
	Environmental issues: Reuse and recycling
	International manufacturing
	JIT evolution and use in the United States
	Mass customization and manufacturing
	Virtual manufacturing
<b>Hino</b>	JIT evolution and use in the United States
<b>Hitachi Seiki</b>	Core manufacturing competencies
<b>Home Depot</b>	Supply chain management
<b>Honda</b>	Concurrent engineering
	Cost analysis for purchasing
	Product design for global markets
<b>Honeywell</b>	Agile manufacturing
	Facilities location decision
	JIT evolution and use in the United States
<b>IBM</b>	Agile Logistics
	Customer service, satisfaction and success
	Environmental issues: Reuse anrecycling
	JIT evolution and use in the United States
	Mass customization and manufacturing
	Total quality management
	Virtual manufacturing
<b>Ikea</b>	Product design for global markets
<b>Imperial Chemical</b>	Facilities location decision
<b>Individual, Inc.</b>	Mass customization and manufacturing
<b>Institute of management Accountants</b>	Activity-based costing: An evaluation
<b>Intel</b>	JIT evolution and use the United States
	Virtual manufacturing

Organization	Article where discussed
<b>ISO</b>	ISO 9000/QS 9000 quality standards
<b>J.B. Hunt</b>	Electronic data interchange in supply chain
<b>J.C. Penny</b>	Bullwhip effect in supply chain
<b>J.D. Edwar</b>	Enterprise resource planning (ERP)
<b>JIPE</b>	Total productive maintenance
<b>JIPM</b>	Total productive maintenance
<b>John Crane Limited</b>	Core manufacturing competencies
<b>John Deere</b>	Agile manufacturing Virtual manufacturing
<b>Johnson and Johnson</b>	Facilities location decision
<b>JUSE</b>	Quality: The implications of Deming's...
<b>Kawasaki</b>	Just-in-time manufacturing
<b>Kia (Korea)</b>	Bullwhip effect in supply chain
<b>K-Mart</b>	Bullwhip effect in supply chain
<b>Kodak</b>	Facilities location decision Environmental issues and operations mgmt.
<b>Komatsu</b>	Total quality management
<b>KPMG</b>	Balanced scorecard
<b>Lawrence Livermore National Laboratory</b>	Electronic data interchange in supply chain
<b>Lawson Software</b>	Enterprise resource planning (ERP) Activity-based costing
<b>Lego</b>	Mass customization: Implementation Product design for global markets
<b>Levi-Strauss</b>	Agile Logistics Human resource issues in manufacturing Mass customization: Implementation Product design for global markets
<b>Lockheed Corporation</b>	Learning curve analysis
<b>Lutron Electronics Company</b>	Mass customization and manufacturing
<b>MacDonnell Aircraft/Aerospace</b>	Manufacturing flexibility Virtual manufacturing
<b>Mack Trucks</b>	ISO 9000/QS 9000 quality standards
<b>MANTECH</b>	Virtual manufacturing
<b>Marks and Spencer</b>	Supplier partnership as strategy
<b>Marriott</b>	Product design for global markets
<b>Mars</b>	Product design for global markets Agile manufacturing
<b>Massachusetts Institute of Technology</b>	Flexible automation
<b>Matlack</b>	Electronic data interchange in supply chain
<b>Matsushita</b>	Target costing Agile manufacturing Mass customization and manufacturing Virtual manufacturing

Organization	Article where discussed
<b>Mazda</b>	JIT evolution and use in the United States
<b>McDonalds</b>	Product design for global markets
<b>McKesson</b>	Bullwhip effect in supply chain
<b>Mercedes Benz</b>	Mass customization and manufacturing Target costing
<b>Metro Bank</b>	Balanced scorecard
<b>Mobil</b>	Facilities location decision
<b>Motorola</b>	JIT evolution and use in the United States Mass customization and manufacturing Product design for global markets Purchasing: The future Statistical process control using control. . . Supplier relationships Total quality management
<b>NAPM</b>	Purchasing: Acquiring the best inputs
<b>Nashua Corporation</b>	Just-in-time manufacturing: Implications Quality: The implications of Deming's. . . Statistical process control using control. . .
<b>National Association of Accountants</b>	Capital investment in advanced technology
<b>National Bureau of Standards</b>	Virtual manufacturing
<b>National Insurance</b>	Balanced scorecard
<b>National Semiconductor</b>	Logistics: Meeting customer's real needs
<b>Navistar International</b>	ISO 9000/QS 9000 quality standards
<b>NCPDM</b>	Logistics: Meeting customer's real needs
<b>Nestle</b>	Facilities location decision
<b>Nissan</b>	JIT evolution and use in the United States Mass customization and manufacturing
<b>NIST</b>	Total quality management
<b>Northern Telecom</b>	Environmental issues and operations mgmt.
<b>Nokia</b>	U-shaped assembly lines
<b>NUMMI</b>	Core manufacturing competencies Just-in-time manufacturing Total quality management
<b>Nuskin</b>	Customer service, satisfaction and success
<b>Olympus Optical Company</b>	Target costing
<b>Omark Industries</b>	JIT evolution and use in the United States Setup reduction
<b>Oracle</b>	Enterprise resource planning (ERP) MRP implementation
<b>Oxford</b>	Bullwhip effect in supply chain
<b>PACCAR, Inc.</b>	ISO 9000/QS 9000 quality standards
<b>Packard Electric</b>	Manufacturing strategy
<b>Panasonic</b>	Agile manufacturing

Organization	Article where discussed
<b>Peoplesoft</b>	Enterprise resource planning (ERP) MRP implementation
<b>Pininfarina, Italy</b>	Outsourcing of product design. . .
<b>Pizza Hut</b>	Product design for global markets
<b>Polaroid</b>	Product design for global markets
<b>Portsmouth Block Mill</b>	History of manufacturing management
<b>Pratt and Whitney</b>	Supplier performance measurement
<b>Procter and Gamble</b>	Global manufacturing rationalization Supply chain management
<b>Quaker Oats</b>	Facilities location decision
<b>RCA</b>	Facilities location decision
<b>Reebok</b>	Mass customization and manufacturing
<b>Renault</b>	International manufacturing
<b>RJR Nabisco</b>	Electronic data interchange in supply chain
<b>Roadway Express</b>	Electronic data interchange in supply chain
<b>Ross Controls</b>	Mass customization
<b>Ryan Transport Management Systems</b>	Quality: The implications of Deming's. . .
<b>Samsonite</b>	Theory of constraints in manufacturing. . .
<b>Samsung</b>	International manufacturing
<b>SAP</b>	Activity-based costing Enterprise resource planning (ERP) MRP implementation
<b>Schrader Bellows</b>	Activity-based costing: An evaluation
<b>Seagate Technologies</b>	Facilities location decision
<b>Siemens</b>	Kanban-based manufacturing systems
<b>Skoda</b>	Manufacturing analysis using Chaos, . . .
<b>Sony</b>	Virtual manufacturing Environmental issues and operations mgmt.
<b>Space Electronics, Inc.</b>	Mass customization and manufacturing
<b>Standard Oil Company</b>	Facilities location decision
<b>Stanford University</b>	Quality: The implications of Deming's. . .
<b>Subway</b>	Product design for global markets
<b>Sun Microsystems</b>	ISO 9000/QS 9000 quality standards
<b>Sundstrand Corporation</b>	Flexible automation
<b>Surgical Focused Care</b>	ISO 9000/QS 9000 quality standards
<b>Taco Bell</b>	Reengineering and process view of. . .
<b>Target</b>	Bullwhip effect in supply chain
<b>Tektronics</b>	New product development through. . .
<b>Telco (India)</b>	Mass customization and manufacturing
<b>Telepad, Inc.</b>	Virtual manufacturing
<b>Tennant</b>	JIT evolution and use in the United States
<b>Texas Instruments</b>	Concurrent engineering Learning curve analysis

Organization	Article where discussed
	Reengineering and process view of . . .
	Supplier performance measurement
<b>The Gap</b>	Logistics: Meeting customer's real needs
<b>Thomas Register</b>	Purchasing: Acquiring the best inputs
<b>Thomson Consumer Electronics</b>	Concurrent engineering
<b>Timkin Company</b>	Performance measurement
<b>Toronto Plastics Ltd.</b>	ISO 9000/QS 9000 quality standards
<b>Toyo Ink</b>	International manufacturing
<b>Toyota</b>	Core manufacturing competencies
	Customer service through system. . .
	JIT evolution and use in the United States
	Kanban-based manufacturing systems
	Lean manufacturing implementation
	Mass customization and manufacturing
	Product development and concurrent. . .
	Product innovation
	Supplier relationships
	Target costing
	Total quality management
<b>Toys-R-Us</b>	Supply chain management
<b>Trident Precision Manufacturing</b>	Performance excellence: The Malcolm. . .
<b>Tyco</b>	Product design for global markets
<b>U.S. Air Force</b>	Flexible automation
	Virtual manufacturing
<b>U.S. Department of Defense</b>	Electronic data interchange in supply chain
	Environmental issues: Reuse and recycling
<b>U.S. Navy</b>	History of manufacturing management
<b>U.S. Postal Service</b>	Performance excellence: The Malcolm. . .
<b>UCAR Composites</b>	Virtual manufacturing
<b>UNEP</b>	Environmental issues in operations mgmt.
<b>Unilever</b>	Logistics: Meeting customer's real needs
<b>United Airlines</b>	Supplier performance measurement
<b>UPS</b>	Electronic data interchange in supply chain
<b>USCAR</b>	Agile manufacturing
	Virtual manufacturing
<b>Valic</b>	Facilities location decision
<b>Volkswagen</b>	Outsourcing of product design. . .
	Purchasing: Acquiring the best inputs
<b>Wal-Mart</b>	Bullwhip effect in supply chain
	Electronic data interchange in supply chain
	Logistics: Meeting customer's real needs
	Purchasing: The future
	Supplier partnership as strategy

Organization	Article where discussed
<b>War Department</b>	Supply chain management
<b>War Production Board</b>	Virtual manufacturing
<b>Watertown Arsenal</b>	Quality: The implications of Deming's . . .
<b>Western Textile Products</b>	Quality: The implications of Deming's . . .
<b>Westinghouse</b>	Scientific management
<b>Whirlpool</b>	Theory of constraints in manufacturing. . .
<b>World Trade Organization (WTO)</b>	JIT evolution and use in the United States
<b>Xerox</b>	Activity-based costing: An evaluation
	Global facility location analysis
	Product design for global markets
	Customer service, satisfaction and success
	Environmental issues: Reuse and recycling
	Quality: The implications of Deming's . . .
	Supplier relationships
	Total quality management
<b>Yamaha</b>	Concurrent engineering
<b>Yamazaki Machinery (Japan)</b>	Capital investment in advanced technology
<b>Yellow Freight</b>	Electronic data interchange in supply chain
<b>Yokohama Corporation (Japan)</b>	Target costing





## Foreword

In the last 20 years, we have witnessed the historic resurgence of manufacturing in the United States. This has been due, in part, to the power of emerging ideas in production and manufacturing management. The widespread use of these new developments has made American manufacturers lean, aggressive and successful competitors.

At the National Association of Manufacturers (NAM), we represent and promote the interests of 14,000 manufacturing firms and organizations. Having worked with manufacturing firms for decades, I am convinced that in this age of heightened global competition, the need for manufacturers to be informed and prepared for the challenges of the global economy is more acute and immediate than ever. The *Encyclopedia of Production and Manufacturing Management* is a valuable contribution by Dr. Paul Swamidass to that end. It provides timely, useful data to managers and manufacturing economists on issues ranging from industrial trends to recent progress in manufacturing management. I expect this single volume encyclopedia to become a standard reference work for managers and students of production and manufacturing management.

Dr. Paul Swamidass has collaborated with the National Association of Manufacturers since 1990 in studying the use of manufacturing technology for improving manufacturing processes in the United States. So far, in collaboration with the National Science Foundation, we have jointly completed three such studies, which are now available as the NAM's "Technology on the Factory Floor" series of reports. Industrial leaders and policy makers have used these reports for nearly ten years. Dr. Swamidass' work reflects a clear understanding of the needs of practicing managers and provides them with useful information that enhances their decision-making and professional performance.

Dr. Swamidass is exceptionally qualified to bring a well-rounded perspective to this complex subject. He holds a degree in mechanical engineering and has done graduate work in production management. He has seven years of industrial experience in production management and for decades has taught production management to students in American universities. I have long found that his strong academic background has complemented his real-world grasp of the problems of practicing managers.

This encyclopedia is an important work. It deserves widespread use by everyone who cares about American manufacturing at the dawn of the new century. I am pleased to commend it to persons who work in manufacturing management and to everyone who cares about the future of American industry.

Washington, D.C.  
July 18, 1999

A handwritten signature in black ink, appearing to read "Jerry J. Kasinowski".

Jerry J. Kasinowski  
President

The National Association of Manufacturers



## Preface

The *Encyclopedia of Production and Manufacturing Management* is a specialized encyclopedia developed to serve as a basic reference resource for the practitioner, researcher, and student. Because of its specialized focus, this one-volume work is able to cover the entire field of production and manufacturing management. It contains factual and conceptual information for fundamental understanding while serving as a starting point for a deeper researched investigation. The material is state-of-the-art, covering the field of operations management and its exciting recent developments. These developments are covered extensively in this volume.

**CONTENT AND PURPOSE:** In the past twenty years, the field of production and operations management has grown with incredible speed, stretching its boundaries in all directions. For example, in the last two decades, production and manufacturing management absorbed in rapid succession several new production management concepts, including manufacturing strategy, focused factory, just-in-time manufacturing, concurrent engineering, total quality management, supply chain management, flexible manufacturing systems, lean production, and the list goes on. These considerable changes and developments in manufacturing highlight the critical need for an efficient, authoritative reference tool for manufacturing management students and practicing managers. Today's manufacturing managers are now expected to think more broadly than their counterparts two to three decades ago. The most notable change has been the need for manufacturing managers to think in technological, strategic and competitive terms. As a matter of record, technological and strategic developments have been the instrumental factors in the resurgence in manufacturing worldwide. The entries in this encyclopedia focus on these on-going technological and strategic changes in production and manufacturing management.

In addition to the technological advances in manufacturing, a special feature of this encyclo-

pedia is the number of successful manufacturers and manufacturing organizations illustrated and examined in the encyclopedia. Throughout the volume, "real-world" examples are drawn from more than 100 international firms whose business operations originate from a variety of countries in Asia, America, and Europe. Moreover, the practices of an array of major manufacturers, including Chrysler, Ford, GM, and Toyota are examined in a number of the topical entries. To assist the reader in locating these operational examples, the table provides an easy-access list of the references of where these "real world" examples can be found in the encyclopedia.

Added to the encyclopedia's entries are two valuable appendixes, each with unique bibliographies. Appendix I is a bibliography organized alphabetically and includes writings on all topics covered by the encyclopedia. Appendix II is a topical bibliography covering 21 broad topics from Capacity Planning to Supply Chain. The second bibliography can greatly speed the search for publications on a given topic. These two appendixes should serve as valuable research tools.

**ORGANIZATION:** The encyclopedia's topical treatments vary in length. The longer articles on important concepts and practices range from three to ten pages. There are about 100 such articles written by nearly 100 authors from around the world. In addition, there are over 1000 shorter entries on concepts, practices and principles. The range of topics and depth of coverage is designed to fit the needs of students and professional managers. The shorter entries provide digests of unfamiliar and complicated subjects. Difficult subjects are made intelligible to the reader without oversimplification.

While some entries – because of their special nature – present a free-form discussion of the topic, the majority of the encyclopedia's entries are structured to provide the following: *introduction or description, historical context of the topic, seminal works, a strategic perspective, a technological perspective, significant analytical models,*

short examples or cases from real-life, implementation issues and references. The material in these articles is arranged in sections using the titles below:

This encyclopedia is an organized summary of basic knowledge and important information in production and manufacturing management. One of the goals of this encyclopedia is to make

Content	Title of the Section
<i>What is it?</i>	Description or Introduction
<i>How did it evolve and seminal works?</i>	Historical perspective
<i>Why is it important?</i>	Strategic perspectives
<i>How is this practiced or implemented?</i>	Implementation
<i>What technologies are essential?</i>	Technology perspective
<i>Problem solving with analytical models</i>	significant analytical models
<i>Effect on performance</i>	Effect
<i>When is it appropriate?</i>	Timing
<i>Where is it used or practiced?</i>	Location
<i>What results and problems to expect?</i>	Results
<i>Who uses them?</i>	Cases
<i>Caveats</i>	Collective wisdom
<i>References to Seminal works</i>	References

A variety of entries examine a strategic perspective on the topic. *The Strategic Perspective* includes some or all of the following:

1. Long-term implications of the process/issue.
2. Its contribution to the organization's competitiveness.
3. The competitive advantages bestowed by the process or practice to the user.
4. Examples, short cases and illustrations.

There are topical entries that require a technological examination of the topic. *The Technological Perspective* includes some or all of the following:

1. The nature and magnitude of investments in specific technologies needed.
2. Historical evolution of the technology.
3. Recent advances in the technology.
4. Benefits of the technology, and illustrative cases.

Driving manufacturing competitiveness has been the strategic and technological responses of manufacturing firms to the increasing level of world wide competition. These two factors – increasing competition and the strategic implementation of manufacturing technology – are inextricably tied together. Hence strategy and technology are examined in the longer entries of the encyclopedia. In addition with the increasing use of hard and soft manufacturing technologies, examining the technological perspectives in appropriate topical entries provides an essential framework for understanding the “on-going technological revolution” in manufacturing and its future developments.

the large volume of material easily accessible to its users. A network of cross-references enables the reader to start from a topic and move speedily to several related topics. Entries are arranged alphabetically (letter-by-letter) for ease of access with each entry ending with generous cross-references. An Index of all entries is provided at the beginning of the encyclopedia, followed by an alphabetical list of longer articles and their authors.

For those interested in pursuing a topic beyond the encyclopedia, longer articles contain several references to seminal and authoritative books and articles. All these references and additional reading materials are listed alphabetically in a comprehensive Bibliography in Appendix I. Appendix II is a topical bibliography covering 21 broad topics. Appendix III is an information resource of selected journals and periodical on production and manufacturing management.

The combination of my many years of teaching university level production and manufacturing management courses and my work with numerous manufacturing firms has underscored to me the need for a functional reference tool for the field. I hope that our efforts in producing the *Encyclopedia of Production and Manufacturing Management* represent an important step in satisfying this need.

**CONTRIBUTING AUTHORS AND BOARD OF ADVISORS:** The Advisory Board, composed of internationally known experts, provided guidance

during the development of the encyclopedia. Collectively, the Board of Advisors for this encyclopedia represents hundreds of years of experience in the research, teaching and practice of production and manufacturing management. The Board's members have published numerous books on the subject, and they know the field intimately. Their input has measurably improved this volume. This distinguished Board of Advisors provided input in selecting the encyclopedia's topical treatment based on each topic's importance, usefulness and currency. Our objective was to be as comprehensive as possible within a one-volume framework. We have made choices realizing that this is a fast moving field and on its horizon there are new developments underway that will need to be addressed in future editions.

Through this encyclopedia, I am delighted to present to the reader the works of over one hundred experts and scholars. The authors of

articles are international experts with a record of research, teaching and publications on the topic. The scholarship of the authors ensures the reliability of the entries. It was my privilege to work with each author.

It was a pleasure to work with Gary Folven, OR/MS publisher, who was also associated with the *Encyclopedia of Management Science and OR*. His experience with encyclopedia development and production provided me with the necessary assurance to undertake the project. Nevertheless, preparing an encyclopedia is a formidable undertaking but I was fortunate to have access to Linda Patillo's skills at Auburn, and the talents of Carolyn Ford and Kristin Piper at the editorial offices of Kluwer.

Paul M. Swamidass  
Professor of Operations Management  
Auburn University

