U.S. Manufacturing: The Engine for Growth in a Global Economy*

by

Thomas J. Duesterberg, Ph.D.
President and Chief Executive Officer
Manufacturers Alliance/MAPI

Federal Reserve Bank of Chicago
Is Midwest Manufacturing at a Crossroads?
Chicago, Illinois
September 30, 2003

* This presentation is based on the Alliance’s just-released book from Praeger Publishers,
U.S. Manufacturing: The Engine for Growth in a Global Economy, October 2003
Copyright © 2003 Manufacturers Alliance/MAPI All rights reserved.
Overview

Principal Themes

1. Manufacturing Is Evolving into a “Solutions-Based,” High Innovation Model

2. Commitment to Technology and Innovation Key to Sustaining Competitiveness and Productivity Growth

3. Manufacturing Sector Leading in Innovation and Productivity; Benefits Spread to Other Sectors; Manufacturing Is Engine for Growth

4. United States Is Ideal Platform for the Model Due to Economic, Political, Social, Cultural Structure

5. U.S. Manufacturers Face Growing Challenges from International Competitors and from Domestic Policy-Related Problems
Manufacturing is Broadening Value Added Beyond Products to “Solutions”

• The market for products that improve living standards will continue to grow. To meet this demand companies will have to adopt more flexible production techniques.

• Value added will move from manufacturing to activities associated with the design, engineering, marketing, and organization of products.

• The rapid development of information technology is creating a new class of products for both consumer and industrial markets.

• Better use of information radically transforms supply chains. Rather than producing products and then trying to sell them, companies are providing solutions to specific customer problems.

• The organizational change needed to take advantage of these trends is usually difficult to implement. Change needs support from cultural, social, and legal institutions—as well as strong leadership at corporate level.
Manufacturers are becoming “solution providers”

- Distinction between manufacturing & services is eroding. Much of the value added by products is in embedded or accompanying services.
- Firms add services to capture a higher proportion of the total value added and build a closer relationship with their customer. Also, service activities often provide a more stable source of revenue.
- As companies concentrate on core competencies, customers increasingly demand total solutions from their suppliers.
- For example, many capital equipment makers are providing capital asset management services:
  - Design, leasing, installation, operations;
  - Preventative maintenance, diagnostics, repair;
  - Cross-platform capabilities.
Complementary Goods and Services Associated With an Automobile

- Transportation
- Gas Purchases
- Stereos/Entertainment
- Navigation
- Maintenance and Repair
- Safety
- Prestige
- Financing
- Communication

Source: Manufacturers Alliance/MAPI
Automation Leaders Have New Opportunities To Thrive in Global Economy

- Firms maximize customer value by delivering optimized combination of: low cost, high quality, fast delivery, rapid innovation, increased flexibility, and product feasibility.

- Capital goods suppliers and automation providers will need new, advanced capabilities to design and deliver solutions tailored to their customers’ strategy and tactics.

- Automating data and information flows is the main challenge for the next decade. Manufacturing firms need to get the right information, to the right person (or machine) at the right time.

- Software systems that better connect manufacturing operations with total supply chain will remain the central battleground.

- Global manufacturers will be increasingly looking for standardized solutions for operations located around the globe. Automation providers will need to be ready to respond around the globe.
Increasingly competitive environment forces firms to focus on providing customer value. Companies will use automation as part of a strategy to optimize over the following objectives:

- **Cost** – minimize the “total cost” of a good or service.
- **Quality** – enhance adherence to customer expectations.
- **Speed** – build to order, reduce delivery lead times.
- **Innovation** – shorten product cycles, increase new features for each product.
- **Flexibility** – customization, change production quickly.
- **Feasibility** – create new product concepts not possible without use of automated, connected equipment.
Manufacturing is evolving to a new species.

**Craft**
- One-off Products
- Flexible, simple tools
- Quality through tinkering
- Build to order

**Henry Ford**
- Flow Production
- Dedicated Tools
- Long Product Life
- Unlimited demand, zero variety

**Mass Production**
- Volume Manufacturing
- Large Buffers
- Long Throughput
- Build to forecast

**Lean Manufacturing**
- Flow Production
- Flexible Tools
- Short Product Life
- Produce to customer demand

---

Historical Time

- 1900
- 1945
- 1995

(Percent that survive in 5-year increments)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>97,285</td>
<td>100</td>
<td>52</td>
<td>36</td>
<td>25</td>
<td>19</td>
<td>14</td>
<td>11</td>
</tr>
<tr>
<td>119,250</td>
<td>100</td>
<td>54</td>
<td>36</td>
<td>26</td>
<td>19</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>145,562</td>
<td>100</td>
<td>49</td>
<td>32</td>
<td>23</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>130,106</td>
<td></td>
<td>100</td>
<td>56</td>
<td>36</td>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>132,106</td>
<td></td>
<td></td>
<td>100</td>
<td>50</td>
<td>34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>143,238</td>
<td></td>
<td></td>
<td></td>
<td>100</td>
<td>53</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Technology Increasingly Drives Growth and U.S. Has Global Technology Lead

- Innovation has become the central pillar of long-run economic growth

- Technology improvement accounts for approximately one-third of growth in 1995-1999

- U.S. investment and R&D concentrated in manufacturing

- U.S. investment higher than foreign competitors; and more efficient

- Rate of technology change embedded in products and processes has dramatically accelerated
U.S. Manufacturing Is the Engine of Innovation-Led Growth

- Accounts for over 70 percent of business-sector R&D (concentrated in computer and electronic products, transportation equipment, chemicals, and industrial machinery).

- Accounts for 50 percent of technology-related royalties and license fees received from foreign companies.

- Accounts for at least 90 percent of all U.S. patent approvals.

- Accounts for 80 percent of all domestic capital goods sales (not including $300+ billion annual sales abroad).

Note: Chart excludes R&D funded by universities, state governments, and nonprofit organizations, which together accounted for 5.3 percent of total R&D funding in 2000.
Source: National Science Foundation
(percent of total)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All manufacturing industries</td>
<td>N/A</td>
<td>91.8</td>
<td>92.1</td>
</tr>
<tr>
<td>Electrical and electronic machinery</td>
<td>36</td>
<td>19.6</td>
<td>26.1</td>
</tr>
<tr>
<td>Machinery, except electrical</td>
<td>35</td>
<td>23.5</td>
<td>22.1</td>
</tr>
<tr>
<td>Professional and scientific instruments</td>
<td>38</td>
<td>11.9</td>
<td>13.7</td>
</tr>
<tr>
<td>Chemical and allied products</td>
<td>28</td>
<td>14.4</td>
<td>13.6</td>
</tr>
<tr>
<td>Other manufacturing industries</td>
<td>N/A</td>
<td>22.4</td>
<td>16.6</td>
</tr>
<tr>
<td>All nonmanufacturing industries</td>
<td>N/A</td>
<td>8.2</td>
<td>7.9</td>
</tr>
</tbody>
</table>

Source: U.S. Patent and Trademark Office
High Tech Investment is a Growing Share of the Economy

Information Processing Equipment and Software

Percent of GDP

Inflation-adjusted

Current dollars

Manufacturers Alliance/MAPI
Growth in Selected Productivity Indexes, 1950-1999
(average annual rates of growth)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multifactor productivity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>1.4</td>
<td>0.5</td>
<td>1.2</td>
<td>2.4</td>
</tr>
<tr>
<td>Nonmanufacturing</td>
<td>2.3</td>
<td>0.5</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Labor productivity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>2.6</td>
<td>2.4</td>
<td>3.2</td>
<td>4.3</td>
</tr>
<tr>
<td>Nonmanufacturing</td>
<td>3.1</td>
<td>1.1</td>
<td>1.1</td>
<td>2.2</td>
</tr>
<tr>
<td><strong>Capital productivity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>-0.3</td>
<td>-1.2</td>
<td>0.7</td>
<td>0.1</td>
</tr>
<tr>
<td>Nonmanufacturing</td>
<td>0.5</td>
<td>-0.8</td>
<td>-0.1</td>
<td>-0.5</td>
</tr>
</tbody>
</table>

Source: U.S. Department of Labor, Bureau of Labor Statistics, and author's calculations
U.S. Productivity Growth, 1992-2002
(percent growth per year)

* First half 2003
Source: U.S. Department of Labor
Reasons for Higher Productivity Growth in Manufacturing

- Emphasis on research and innovation
- New technology development
- Flexible, efficient management practices such as Lean, Six Sigma
- Greater exposure to global markets
  - Bigger markets
  - More competition
  - More cross-border joint ventures
“Especially important is the fact that the service sector acquires most of its technology from manufacturing firms. . . This fact emphasizes the substantial dependency of services on manufacturing firms for technology and thus the critical role of the myriad communications and market transactions between the two sectors.”

Source: G. Jassey, R&D and Long-Term Competitiveness: Manufacturing’s Central Role in a Knowledge-Based Economy (National Institute of Standards and Technology)
## Productivity Growth by Industry, 1990-2000
*(average annual rate of change)*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wholesale trade</td>
<td>2.7</td>
<td>4.0</td>
<td>3.3</td>
</tr>
<tr>
<td>Durable goods</td>
<td>4.8</td>
<td>6.1</td>
<td>5.4</td>
</tr>
<tr>
<td>Nondurable goods</td>
<td>0.2</td>
<td>1.2</td>
<td>0.7</td>
</tr>
<tr>
<td>Warehousing</td>
<td>4.4</td>
<td>-2.0</td>
<td>1.2</td>
</tr>
<tr>
<td>Long-distance trucking</td>
<td>2.4</td>
<td>0.9</td>
<td>1.7</td>
</tr>
<tr>
<td>Rail transportation</td>
<td>5.5</td>
<td>4.5</td>
<td>5.0</td>
</tr>
<tr>
<td>Retail trade</td>
<td>1.6</td>
<td>3.2</td>
<td>2.4</td>
</tr>
</tbody>
</table>

*Source: U.S. Department of Labor, Bureau of Labor Statistics*
Shares of Domestic Expenditures on R&D in OECD Countries, 2000
(in $ billions at PPP)

- **United States**: $282.3 billion (46.8%)
- **European Union**: $174.7 billion (28.9%)
- **Japan**: $98.6 billion (16.35%)
- **Korea**: $19 billion (3.15%)
- **Other**: 4.8%

Source: OECD
Investment in Knowledge in Selected Countries, 1998
(as a percent of GDP)

United States
- R&D: 2.6
- Software: 1.5
- Higher Education: 1.9

Japan
- R&D: 3.0
- Software: 1.1
- Higher Education: 0.6

Germany
- R&D: 2.3
- Software: 1.2
- Higher Education: 0.7

United Kingdom
- R&D: 1.8
- Software: 1.3
- Higher Education: 0.8

European Productivity Lags . . .

Compensation per employee

Labour productivity

Profit margins

Source: European Commission
Comparative Productivity in the Auto Sector

Real labor productivity for automotive sector; index: United States = 100 in 1999

Source: Institut National de la Statistique et des Études Économiques (INSEE); Japan Statistics Bureau & Statistics Center; Statistisches Bundesamt Deutschland; US Census Bureau

High-Tech Exports, 1980-1998

Source: National Science Foundation, *Science & Engineering Indicators--2002*
U.S. Manufacturing is the Principal Engine of Growth

- Despite secular decline as proportion of GDP, growth remains strong

- Manufacturing provided 22 percent of overall U.S. growth in 1992-2000 and averaged 4.8 percent versus 3.4 percent for nonmanufacturing; if the 1990-1991 recession is included, growth in 1989-2000 averaged 3.3 percent in manufacturing and 3.0 percent in nonmanufacturing

- Productivity boom centered in manufacturing

- Products with embedded new technologies come almost exclusively from manufacturing sector

- Manufacturing sector also leads in management innovation; Lean, Six Sigma, JIT, Supply Chain Integration, etc.
Manufacturing Closely Linked to the Economy: Report of its Demise Is Premature

<table>
<thead>
<tr>
<th>Decade</th>
<th>Annual growth (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920s</td>
<td>4.4</td>
</tr>
<tr>
<td>1930s</td>
<td>-0.6</td>
</tr>
<tr>
<td>1940s</td>
<td>6.1</td>
</tr>
<tr>
<td>1950s</td>
<td>5.2</td>
</tr>
<tr>
<td>1960s</td>
<td>5.6</td>
</tr>
<tr>
<td>1970s</td>
<td>3.0</td>
</tr>
<tr>
<td>1980s</td>
<td>2.0</td>
</tr>
<tr>
<td>1990s</td>
<td>4.1</td>
</tr>
<tr>
<td>2000s (forecast)</td>
<td>2.6</td>
</tr>
</tbody>
</table>

Manufacturing industrial production (monthly)

GDP (annual)
Manufacturing Closely Linked to the Economy

Index 1997=100

Manufacturing industrial production (monthly)
GDP (annual)
### U.S. Manufacturing Cash Flow (Undistributed Profits Plus Depreciation Allowances), 1990-2001

<table>
<thead>
<tr>
<th>Year</th>
<th>Millions of dollars</th>
<th>Percent of total corporate cash flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>169,469</td>
<td>37.2</td>
</tr>
<tr>
<td>1991</td>
<td>152,544</td>
<td>32.2</td>
</tr>
<tr>
<td>1992</td>
<td>156,937</td>
<td>30.7</td>
</tr>
<tr>
<td>1993</td>
<td>166,462</td>
<td>30.9</td>
</tr>
<tr>
<td>1994</td>
<td>205,249</td>
<td>33.8</td>
</tr>
<tr>
<td>1995</td>
<td>234,362</td>
<td>34.7</td>
</tr>
<tr>
<td>1996</td>
<td>241,834</td>
<td>33.9</td>
</tr>
<tr>
<td>1997</td>
<td>257,725</td>
<td>33.3</td>
</tr>
<tr>
<td>1998</td>
<td>225,528</td>
<td>30.9</td>
</tr>
<tr>
<td>1999</td>
<td>245,950</td>
<td>30.4</td>
</tr>
<tr>
<td>2000</td>
<td>231,573</td>
<td>30.0</td>
</tr>
<tr>
<td>2001</td>
<td>198,239</td>
<td>25.3</td>
</tr>
</tbody>
</table>

*Source: U.S. Bureau of Economic Analysis*
Favorable U.S. Macroeconomic and Political Framework for Stimulating Innovation and Growth in Manufacturing

- Well-established rule of law
  - IPR protection
  - Dispute resolution
  - Transparency
  - Favorable commercial code

- Superior financial system
  - Equity culture
  - Venture capital
  - High-yield bonds
  - Attractive market for foreign investors
Favorable U.S. Macroeconomic and Political Framework for Stimulating Innovation and Growth in Manufacturing (continued)

- Educated, flexible workforce (open to immigration)
- Management dedicated to constant improvement and open to change
- Good economic infrastructure
- Size, wealth, and sophistication of market
- Open trade and investment
- Leader in science and technology
Some Problems in Developed Countries

- Rigid labor markets
- Lack of worker mobility
- Sanctioned or indirect protectionism
- Lack of flexible financial systems
- Risk-taking cultures are rare
- Aging labor markets, little immigration
- Heavy hand of regulation
- Poorly developed bankruptcy codes
- Resistance to exit by established firms
Risks in Doing Business in Developing Countries

- Sovereign risk: Russia, Africa
- Transfer risk: Capital controls common
- Currency risk: East Asia
- Economic risk: Argentina
- Political/Institutional risk: India
- IPR risks: China
- Health/Environmental risks: Pacific Rim (SARS)
### Geographic Distribution of U.S. Exports and Imports, 1990 and 2002

<table>
<thead>
<tr>
<th></th>
<th>Exports</th>
<th>Imports</th>
<th>Exports</th>
<th>Imports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>21.1</td>
<td>24.6</td>
<td>18.1</td>
<td>19.1</td>
</tr>
<tr>
<td>European Union</td>
<td>26.3</td>
<td>22.0</td>
<td>20.0</td>
<td>20.6</td>
</tr>
<tr>
<td>Japan</td>
<td>12.3</td>
<td>7.9</td>
<td>18.2</td>
<td>11.1</td>
</tr>
<tr>
<td>Other industrialized economies</td>
<td>3.4</td>
<td>3.2</td>
<td>2.4</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>TOTAL ADVANCED</strong></td>
<td><strong>63.1</strong></td>
<td><strong>57.6</strong></td>
<td><strong>58.7</strong></td>
<td><strong>52.7</strong></td>
</tr>
<tr>
<td>Mexico</td>
<td>7.2</td>
<td>14.9</td>
<td>6.0</td>
<td>12.3</td>
</tr>
<tr>
<td>China</td>
<td>1.2</td>
<td>3.4</td>
<td>3.1</td>
<td>11.4</td>
</tr>
<tr>
<td>Southeast Asia</td>
<td>9.4</td>
<td>11.1</td>
<td>15.8</td>
<td>13.8</td>
</tr>
<tr>
<td>Other developing economies</td>
<td>12.0</td>
<td>7.6</td>
<td>11.3</td>
<td>4.3</td>
</tr>
<tr>
<td><strong>TOTAL DEVELOPING</strong></td>
<td><strong>29.9</strong></td>
<td><strong>37.0</strong></td>
<td><strong>36.1</strong></td>
<td><strong>41.7</strong></td>
</tr>
<tr>
<td>Unclassified</td>
<td>7</td>
<td>5.4</td>
<td>5.2</td>
<td>5.6</td>
</tr>
</tbody>
</table>

Note: Southeast Asia includes Taiwan, South Korea, Hong Kong, Singapore, Malaysia, Philippines, Thailand, and Indonesia.
U.S. Has Policy Challenges To Sustaining Manufacturing Engine of Growth

Broad Policy Support for the Manufacturing Engine of Growth

• Wider freedom for creativity and innovation
• Sustained high level of investment
• Increased level of domestic savings
• More open international trade and investment
• More educated and flexible work force
• Reduced and more market-oriented government regulatory role
Specific Policy Proposals to Address Impediments to the Manufacturing Engine of Growth

- Fiscal reform
  - Corporate tax reduction
  - Encourage savings/investment
- Tort reform
- Better financial market standards and transparency
- Higher educational achievement, especially in physical sciences, engineering
- More cost-effective health care services
- Improved environmental policies
- Continued deregulation (especially energy and telecommunications)
- Free trade in manufactures
- Return to market-based currency exchange rates
Questions and Comments:

Thomas J. Duesterberg, Ph.D.
President and Chief Executive Officer
Manufacturers Alliance/MAPI Inc.
1525 Wilson Boulevard, Suite 900
Arlington, VA 22209
703/841-9000
tduesterberg@mapi.net