The World Is Flat: Globalization of Materials R&D

Implications for the Manufacturing Industry

Diran Apelian
WPI, Metal Processing Institute
Worcester, MA 01609 USA
OUTLINE

- Context, Issues, Threats
- What has not Worked
- What we need to do
The End of the Cold War Era

USA the only remaining superpower ... Our Responsibilities? Societal context?
Historical Context

- 1970’s - stagflation in USA
- Japanese Industries Investing in R&D
  ... and fierce competition
- Omnibus Trade and Competitiveness Act of 1988; NIST charged to establish ATP (Advanced Technology Program)
- 1990-2000 focus on efficiency and quality
**U.S. Bicycle Distribution Split Between Mass Retail Channel and Independent Bicycle Dealers (IBD) Channel**

---

<table>
<thead>
<tr>
<th><strong>Mass</strong></th>
<th><strong>Independent Bicycle Dealers</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>(Wal-Mart, Target, Kmart Sports Authority, etc.)</td>
<td>(“Mom &amp; Pop” Operations: 4,000 - 5,000 outlets)</td>
</tr>
<tr>
<td>• 14.5 Million units/year (growing).</td>
<td>• 2.5 Million units/year (declining).</td>
</tr>
<tr>
<td>• 80% Kids Bikes.</td>
<td>• 80% Adult Bikes.</td>
</tr>
<tr>
<td>• Typical Retail Price Points: $24 - $150.</td>
<td>• Typical Retail Price Points: $199 - $6,000.</td>
</tr>
</tbody>
</table>

Credit: D. Graber, Huffy
As Mass Distribution Has Grown, Retail Price Points have Declined Significantly Driven Primarily by Impact of “Wal-Mart and China”

Average Invoice Prices to Retailers ($)

Credit: D. Graber, Huffy
Until Mid-1980's 75% of the Bikes Sold in the U.S. Market Were Made in the U.S. Market

Credit: D. Graber, Huffy
However, Things Started to Change in the 90’s

U.S. Consumer, Retailers Have Supported & Driven the Transformation
In Summary, China has Won the Bicycle Manufacturing War With:

- Cheap Labor
- Lower Factory Overheads
- Government Export Rebates
- Currency (Probably Undervalued)

Which More Then Offset Higher:

- Ocean Freight
- 11% Import Duties

Plus, Quality and Response Time are Competitive

Credit: D. Graber, Huffy
China Rapidly Penetrating Other Metal Processing Industries Historically Done in the United States - Examples:

- **Automotive** - General Motors Sourced 9% of Their Aluminum Wheels for the U.S. Market, From China in 2003. Hope to Source 40% by 2006.

- **Aerospace** - Lower Technology Castings for Jet Engines are Being Produced in China - you can Expect Higher Technology Parts to Follow.

Credit: D. Graber, Huffy
China, at the Current Time, is not without its issues as a supply base - *current top five are*:

- Raw Material Inflation (*Steel, Resins, etc.*)
- Export Rebates Being Reduced
- Infrastructure Lagging (*Power Shortages, etc.*)
- Currency (*Probably Undervalued*)
- Political Uncertainty

Credit: D. Graber, Huffy
Ipsen International
Process Heating
Manufacturing in China

Mr. Mario Ciampini
President & CEO
Ipsen International, Inc.

Wednesday, May 26, 2004 Metal Processing Institute - MPI
Annual GDP Growth in China

<table>
<thead>
<tr>
<th>Year</th>
<th>Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>8.8%</td>
</tr>
<tr>
<td>1998</td>
<td>7.8%</td>
</tr>
<tr>
<td>1999</td>
<td>7.1%</td>
</tr>
<tr>
<td>2000</td>
<td>8.0%</td>
</tr>
<tr>
<td>2001</td>
<td>7.3%</td>
</tr>
<tr>
<td>2002</td>
<td>8.0%</td>
</tr>
<tr>
<td>2003</td>
<td>8.8%</td>
</tr>
<tr>
<td>2004E</td>
<td>8.5%</td>
</tr>
</tbody>
</table>
Market Study — Bain & Company

• In 1994 Ipsen commissioned Bain & Company to perform a detailed market study ($0.5 million) for the Process Heating Industry.

• Results denoted that market would *quadruple* for the period 1996 to 2005 (10 years) due to very fast growth in the *Automotive, Aerospace, Steel and Aluminum sectors*.

• Significant offshore demand and manufacturing base established by American and European global companies.
## Development of Automotive Industry

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vehicle production</strong></td>
<td>1,000,000</td>
<td>2,000,000</td>
<td>3,000,000</td>
<td>4,000,000</td>
</tr>
</tbody>
</table>
Restructuring of the Automotive Industry

Three Giants:

**FAW** Group in Northeast China

**SAIC** in Shanghai

**Dongfeng Group** in Middle of China

These three groups cover about 50% of total vehicle production in China.
MPI CHINA DELEGATION VISIT
December 8-17, 2004

MPI DELEGATION VISIT TO CHINA’S RESEARCH & EDUCATIONAL CENTERS IN METAL PROCESSING
Shanghai Jiao Tong University

Xuhui Campus - Haoran Research Building
Shanghai Jiao Tong University

Minhang Campus (New Campus)
Shanghai Jiao Tong University

Minhang Campus - Library
SHARE DATA
OUTLINE

- Context, Issues, Threats
- What has not Worked
- What we need to do
Overview Figure 2.
Changes in share of Federal academic research obligations, by field: 1990–99

- Physical sciences
- Engineering
- Environmental sciences
- Mathematics
- Psychology
- Social sciences
- Other sciences not elsewhere classified
- Computer sciences
- Life sciences

Percentage-point share change

SOURCE: NSF/SRS, Survey of Federal Funds for Research and Development

Science & Engineering Indicators – 2002
Funding for Academic Earmarks

Source: The Chronicle of Higher Education.
Peer Review Process

“The peer review advisory process for the allocation of federal government support for scientific research has served our nation well over many decades and...should be maintained as the principal factor in determining how federal research funds are awarded.”

NRC Committee's Recommendations for the Future of Physics, July 2001
Challenge: Workforce Issues

• Decline in US college-age population
  – U.S. education system needs to improve

• Heavy reliance on foreign-born scientists—One in Four
  – Academia
    • engineering (40%), computer science (35%) and mathematics (28%)
  – Industry
    • 33%-overall, engineering & computer (50%), mathematics (33%)
  – Federal Government
    • 16%

Credit: Dr. Kathie Olsen -ASTRA

Number of degrees


United States

Europe

Asia

NOTE: Europe includes France, Germany, and the United Kingdom. Asia includes China, India, Japan, South Korea, and Taiwan.

Source: Science & Engineering Indicators 2002
The Impact on Society

Innovation Impact
73% of the citations in U.S. industry patents are from research conducted at publicly supported institutions.

Economic Growth Impact
Approximately a dozen economic studies (including those of Nobel Laureate Robert Solow) show that technological progress accounts for 50% of economic growth, for all time periods studied (various intervals from 1869-1979).

Workforce Impact
Strong correlation between federally R&D funding and creation of technically trained workers.
Something to Ponder

If there are not enough trained people in the U.S., corporations will have to move R&D operations to where the trained people are. The pilot plant follows, because you need the R&D people nearby to help make it work. The manufacturing plant follows the pilot plant. Distribution, sales, and management follow the manufacturing. Once this process is started, it is not reversible.

Corporations may not like it but they will survive if there is no R&D in the U.S. They will just go overseas. The U.S. economy, however, will not recover from the loss of this business.

*Quoted with permission from Bill Joyce, CEO of Hercules and previously CEO of Union Carbide*
OUTLINE

- Context, Issues, Threats
- What has not Worked
- What we need to do
“…For the past 25 years, we have optimized our organizations for efficiency and quality. Over the next quarter century, we must optimize our entire society for innovation…”
National Innovation Initiative
- study and recommendations*

Recommendations - Three Categories

**Talent** - support a culture of collaboration, a symbiotic relationship between research and commercialization, and life-long skill development.

**Investment** - Give innovators the incentives and resources to succeed.

**Infrastructure** - support a new industry-academia alliance, Flexible IP regime, bolster manufacturing enterprises...etc.

Innovation is Key

“Research is the transformation of money into knowledge;
Innovation is the transformation of knowledge into MONEY”

Geoffrey Nickelson, 3M