

Innovation and the Future of Manufacturing

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Five key points

- The perception of manufacturing as a declining sector in advanced economies is mistaken.
- There are no sunset industries, only sunset activities.
- Innovation is about more than discovery and invention.
- All innovation ecosystems are not the same.
- The 'hidden dimension' of innovation.



The core questions

How can we make globalization and rapid technological change work for our society?

What choices do we have to build an economy that is productive and competitive, and that provides opportunities for people in all parts of society to do well?



Three kinds of competition

FIRMS



PLACES



PEOPLE



Different rules; different strategies



The Globally-Integrated Enterprise

“A globally integrated company locates operations and functions anywhere in the world based on the right cost, the right skills and the right business environment.

. . . . Work flows to the places where it will be done best . It’s like water finding its own level. The forces driving it are irresistible. The genie's out of the bottle, and there's no stopping it.”

-- IBM CEO Sam Palmisano



As the competition between **FIRMS**
globalizes

. the competition between
PLACES intensifies.



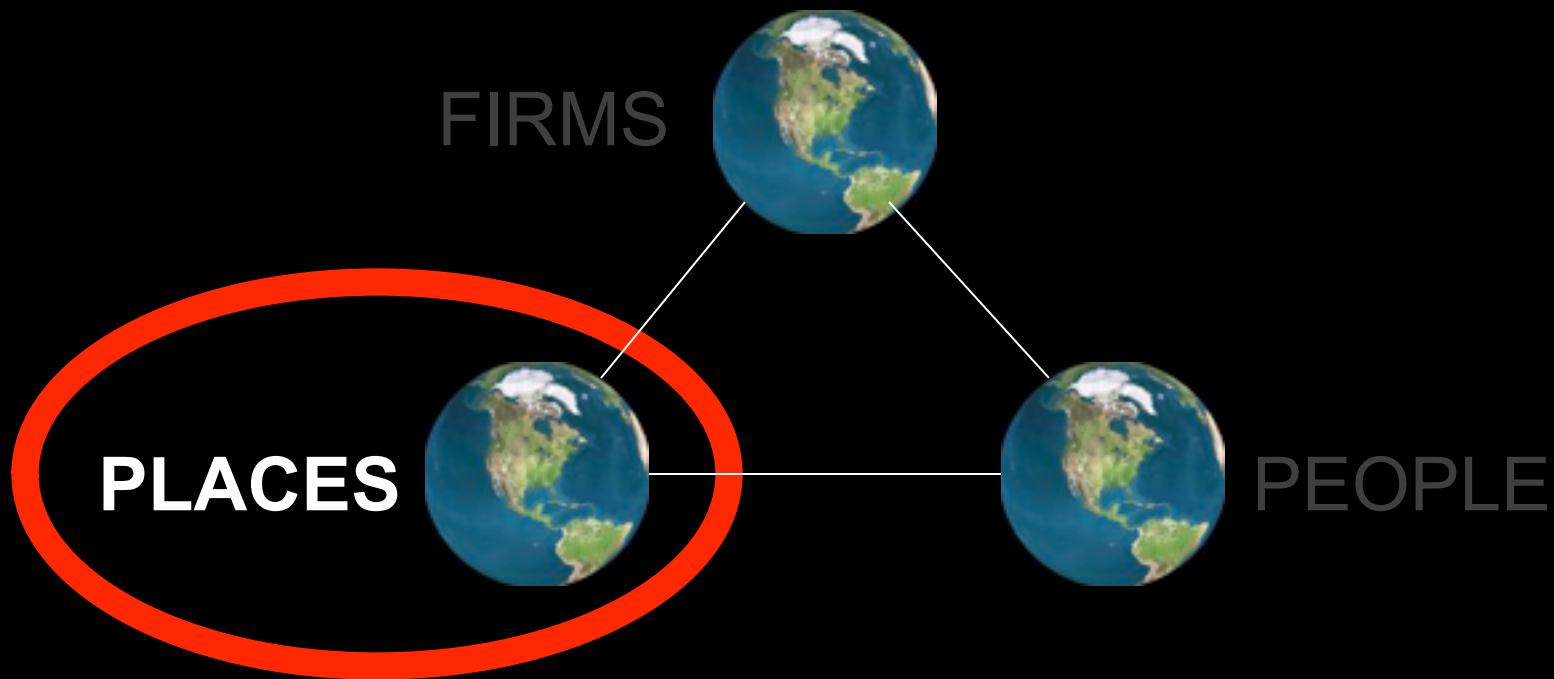
The IPC's research agenda

How **FIRMS** compete to sell products and services.

How **PLACES** compete for the most desirable economic activities.

How **PEOPLE** prepare to compete, through education, skill development, etc.

Today's topic



How can national/regional economies prosper in the rapidly changing, increasingly open global economy?
And what is the role of manufacturing?

The importance of innovation

- Productivity growth
- Resilience
- Adaptability



Two competing innovation scenarios

'Hollowing-out'

- ◆ Local companies reaching farther afield to tap into the global network of ideas and skills, and eventually moving out altogether.

'Agglomeration'

- ◆ Local companies strengthening their local ties
- ◆ Local/regional economy emerging as a center of new knowledge creation and application, stimulating and attracting new enterprise.

What will determine the outcome?



What makes for a creative,
innovative economy?

Investment.

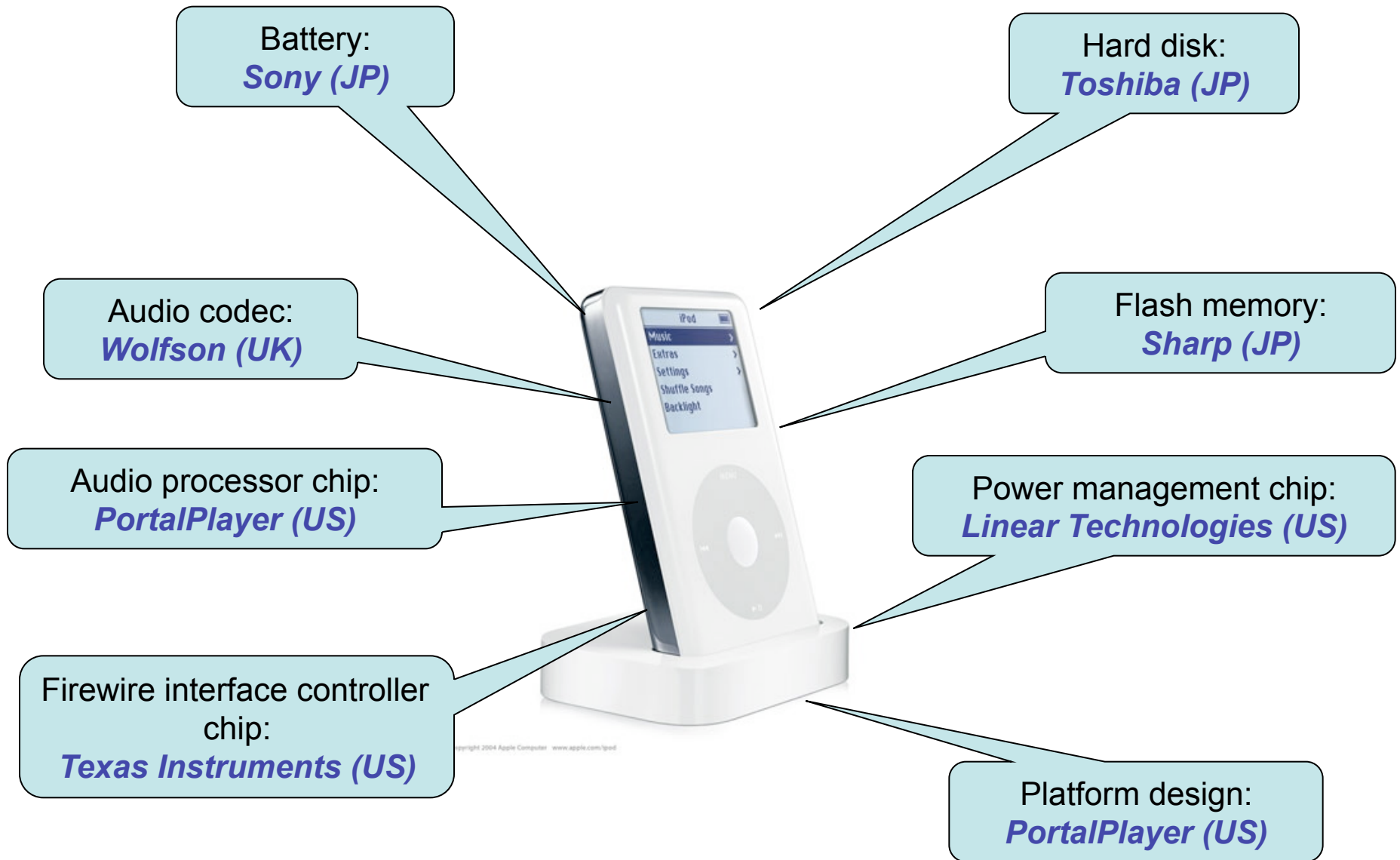
Risk-taking. Confidence.
'Animal spirits'.



The work of innovation has changed.

- Complexity and multidisciplinary
 - Products
 - Innovation tools
 - Production systems
- Globally distributed
- Increased reliance on external sources of knowledge
- Open standards, open systems
- Increased role for small, entrepreneurial business





Service-enhanced products.

Product-enhanced services.



The five “ANDS” of innovative places

- Firms **AND** places
- Products **AND** services
- Clusters **AND** hubs
- Creativity **AND** efficiency
- Invention **AND** adoption



An innovative region is innovative because of . . .

Strong local generation of new technologies



Low resistance to adoption of new technologies (from all over)



In innovation policy, one size doesn't
fit all.





Local Innovation Systems Project
MIT Industrial Performance Center



LIS Case Portfolio

Country	Location	Industry/technology
USA	Rochester, NY	Opto-electronics
USA	Akron, OH,	Advanced polymers
USA	Allentown, PA	Opto-electronics/steel
USA	Boston, MA	Bioinformatics
USA	New Haven, CT	Biotechnology
USA	Charlotte, NC	Motor sports
USA	I-85 Corridor, NC/SC	Autos
USA	Alfred-Corning, NY	Ceramics
USA	Youngstown, OH	Steel/autos
USA	Morgantown, WV	Biometrics
Finland	Tampere	Industrial machinery
Finland	Turku	Biotechnology
Finland	Seinajoki	Industrial automation
Finland	Pori	Industrial automation
Finland	Helsinki	Wireless
Finland	Oulu	Medical
UK	Central Scotland	Opto-electronics
UK	Aberdeen	Oil and gas
UK	Cambridge	Bioinformatics
Taiwan	Taipei-Hsinchu	Electronics
Taiwan	Taipei-Hsinchu	Software
Japan	Hamamatsu	Opto-electronics
Japan	Kyoto	Electronics
Norway	Stavanger	Oil and gas



LIS Interviews

	Number of interviews
United States	308
Finland	238
United Kingdom	103
Japan	84
Norway	31
TOTAL	764

An additional 117 interviews were carried out in Taiwan.



Four pathways of regional innovation-led growth

- I. Indigenous creation of new industry
Silicon Valley: Personal computers
Boston: Systems biology
- II. Transplantation of new industry into region
I-85 corridor (NC/SC): Automotive industry
Taipei-Hsinchu corridor (Taiwan): Electronics industry
- III. Diversification of existing industry into new
Akron, OH: Tires → Advanced polymers
Rochester, NY: Cameras, copiers → Opto-electronics
- IV. Upgrading of existing industry
Tampere, Finland: Industrial machinery
Charlotte, NC: Motor sports (NASCAR)



Type I:
Indigenous
creation of new
industry

Type II:
Transplantation
of new industry

Type III:
Diversification of
old industry into
related new

Type IV:
Upgrading of
mature industry



- Success conditions (and failure modes) for each of these pathways are different.
- Patterns of innovation in each case are different
- Roles of educational institutions, financial institutions, government, and others for each pathway are different



TYPE I

TYPE IV

CREATING NEW INDUSTRIES

UPGRADING EXISTING INDUSTRIES

Financing

Angel/venture capital (private and public); active asset management



Internal financing, supplier financing, gov't. financing for demonstrations

Innovation culture

Science-driven; entrepreneurial



Customer-driven; TQM; continuous improvement; 'best practice'

Local anchors

Research universities
Government labs



Lead firms
Lead customers/users

Education and training

Ph.D.-level scientists and engineers; entrepreneurial business education



BS/MS-level engineers; faculty-student knowledge of industry practices and business problems. Internships, rotations.

Leadership in the public space

Creating an identity ('evangelism'); standard-setting



Participate in regulatory processes; global scanning for best practice; 'foresight' exercises

Technology transfer

Proactive tech transfer from universities & gov. labs; startup-oriented



Long-term relationships between universities and established firms

The Hidden Dimension of Innovation

The next frontier of innovation management and
policy?



Flashes of lightning.

Eureka moments.

**“You have to kiss a lot of frogs
before you find the prince.”**



**“Designing new products is
problem-solving!”**

**But how do you know
you’re solving the right
problem?**

**Where do the problems
come from in the first
place?**



“ANALYTICAL”

A problem-solving project

Clear end-point

Push for clarity and closure

Listen to the voice of the customer

“INTERPRETIVE”

A process

Open-ended

Thrive on ambiguity

Develop an instinct for what the customer wants



Two radically different ways of managing.

Analytical managers . . .

- Pick the team
- Define the goals
- Allocate the resources
- Demand clarity
- Convene meetings to resolve conflicts and eliminate ambiguity
- Push for closure

“I’m looking for something I’ve never seen, so how can I tell them what to do?”

-- Robert Altman



Two radically different ways of managing.

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Interpretive managers (Cocktail party hostesses)

- Select the 'guests'
- Make the introductions
- Start the conversations
- Seed the conversations with new topics
- Keep the conversation going; stave off boredom and controversy; avoid breakdown
- Refresh the conversation with new ideas, new people



Analytical processes are most useful when the alternatives are well understood and can be distinguished from each other.

Options exist. Probabilities.

Interpretive processes are most useful when the possible outcomes are unknown and the task is to create them and understand their properties.

Options don't yet exist.
Radical uncertainty.



‘Sheltered’ spaces for interpretive processes.



Examples of interpretive spaces

- Industrial districts (clusters) of small and medium-sized firms
- Open source software communities
- Intel and computer peripherals suppliers
- IBM's "ThinkPlace"
- The U.S. Food and Drug Administration
- Bell Labs (not any more)
- Stanford University, MIT, etc.



Why interpretive processes are becoming more important in advanced economies (I)

- Decline of mass production & rise of customization in products and services
 - ◆ In traditional mass production systems, the supplier wants to freeze the design ASAP
 - ◆ As the cost of customization decreases, new premium on processes that continuously re-interpret the world of the customer
 - ★ 'co-invention' with the customer (especially in services)
 - ★ 'travel with the customer', responding to and anticipating changes in structures, environments, preferences, etc.
 - ◆ Need to link developers/innovators with customers and with practitioners in the rest of the production system.



Why interpretive processes are becoming more important in advanced economies (II)

- Decline of mass production & rise of customization in products and services
- Blurring of industry and technology boundaries & increased interdisciplinarity
 - ◆ Example: computing/software/information services/business consulting/media/entertainment/etc.
 - ★ What is IBM? What is Google?
 - ◆ Example: from microelectronics (physics + EE) to nanotechnology (physics + chemistry + EE + materials science + biology + chemical engineering)
 - ◆ Companies, technologists need to learn each other's languages
 - ◆ Need for bilingual/multilingual managers and engineers



Why interpretive processes are becoming more important in advanced economies (III)

- Decline of mass production & rise of customization in products and services
- Blurring of industry and technology boundaries & rise of interdisciplinarity

■ Technology increasingly 'touching' people

- ◆ Ubiquitous computing (pervasive Internet, human-centered computing)
- ◆ IT applications shifting from back-office to people-oriented, customer-facing services
- ◆ New technologies facilitating many-to-many conversations
 - ★ E.g., Web 2.0 (social networking, Wikis, etc.)
- ◆ Need/opportunity to integrate cultural factors, social structures, environmental influences into innovation



Conclusions

- Problem solving and interpretation. Creative economies need both.
 - “The test of a first-rate intelligence is the ability to hold two opposing ideas in mind at the same time and still retain the ability to function.”
 - -- F. Scott Fitzgerald
- Interpretive spaces for creative activity must be actively promoted and protected.
 - ★ Identify. Measure. Lead.
- The true source of creativity in the economy: the ability to integrate across organizational, cultural, and intellectual boundaries.

