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**The Black Box of Intangible Capital:  
Wanted! Data from Deep within Firms**

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# Outline of presentation

- **Illustration of the issue**
- **Measuring investments in innovation**
- **Microeconomic perspectives**

## Illustration of the issue



Grab your iPod, flip it over, and read the script at the bottom. It says: "Designed by Apple in California. Assembled in China." Where the gizmo is made is immaterial to its popularity. It is great design, technical innovation, and savvy marketing that have helped Apple Computer sell more than 40 million iPods. Yet the folks at the BEA don't count what Apple spends on R&D and brand development, which totaled at least \$800 million in 2005. Rather, they count each iPod twice: when it arrives from China, and when it sells. That, in effect, reduces Apple -- one of the world's greatest innovators -- to a reseller of imported goods.

# Mandel's Observations

- Macroeconomic estimates of business investment are understated b/c they miss **inputs** to innovation
  - ◆ Corrado, Hulten, and Sichel (2005) suggested inputs to innovation--such as Apple's design and branding--are business investment from an economic point of view.
  - ◆ “any use of resources today designed to increase the productive capacity of the firm in the future is investment.”
- “Transactions” of innovation **outcomes** (e.g., original blueprints and designs) are not tracked appropriately in our statistical system
  - ◆ .... Apple, Cisco, and fabless semiconductor makers such as Nvidia are regarded as “resellers” of imported goods!

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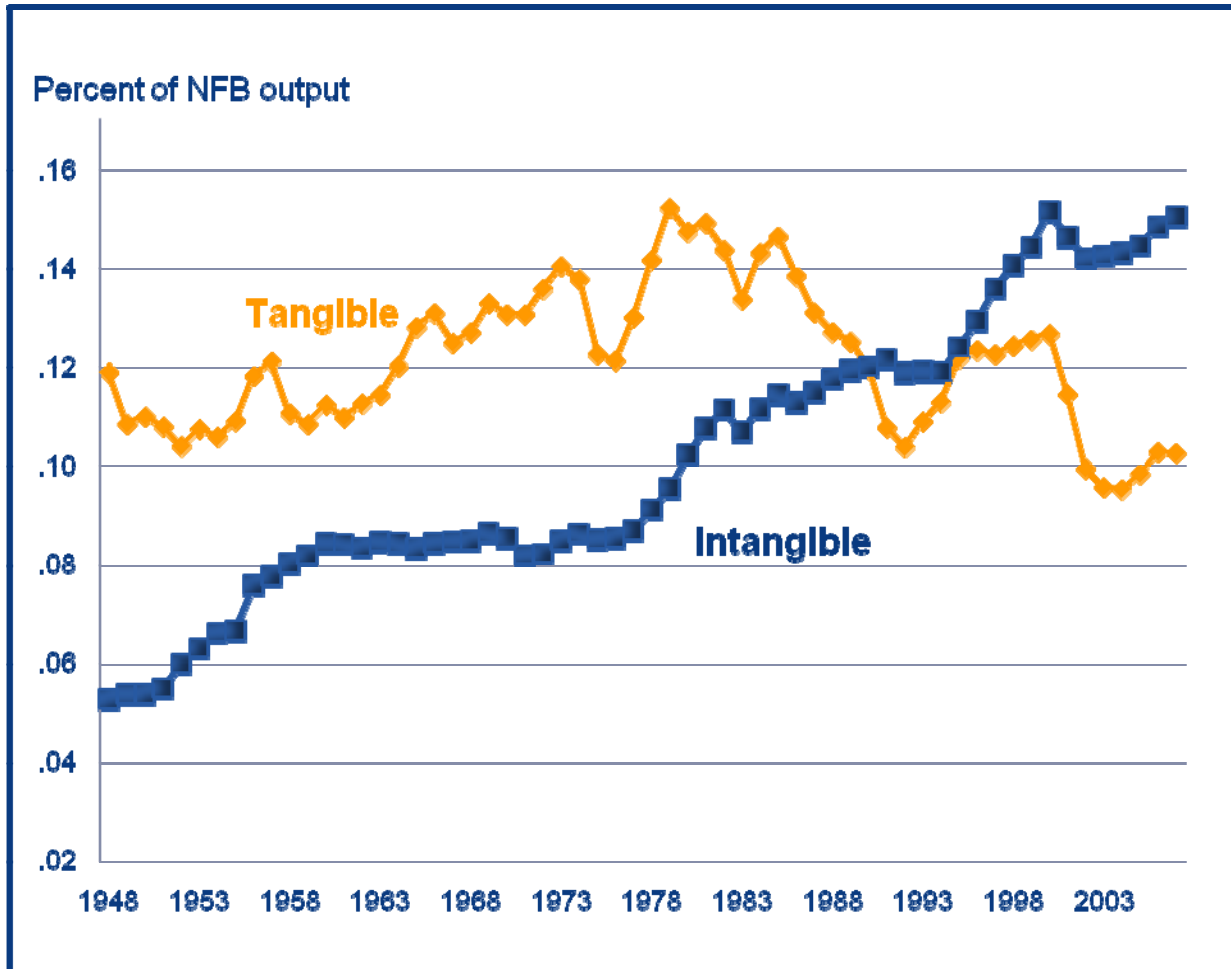
# When firms commit to innovation...

- The evidence of commitment is an **allocation of resources** to developing and implementing:

1. New products	3. New marketing methods
2. New production or distribution processes	4. New methods for organizing and executing business practices
Source: Oslo Manual	

- ... which is akin to the “economic” view in CHS.
- CHS offered a **scheme to measure intangible investment** and capital.

# Intangible vs. tangible investment rate rises over time in the United States

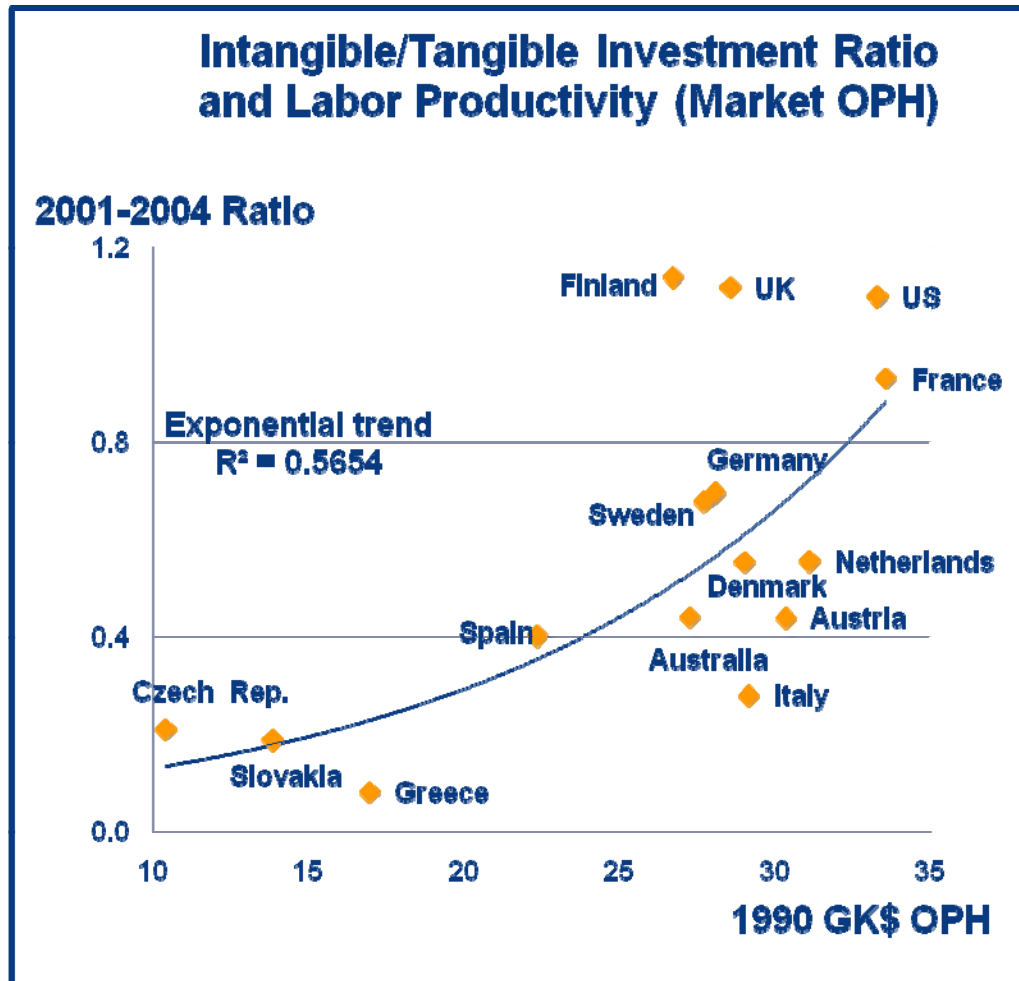


## Intangible capital

- Computerized information
  - Software
  - Databases
- Innovative property
  - Tech R&D
  - Nontech. R&D
- Economic competencies
  - Marketing and branding
  - Strategic firm practices

Source: Unpublished update to CHS, Corrado (forthcoming), NAS workshop volume. Last point plotted is 2007.

...and their ratio is positively correlated with the *level* of labor productivity



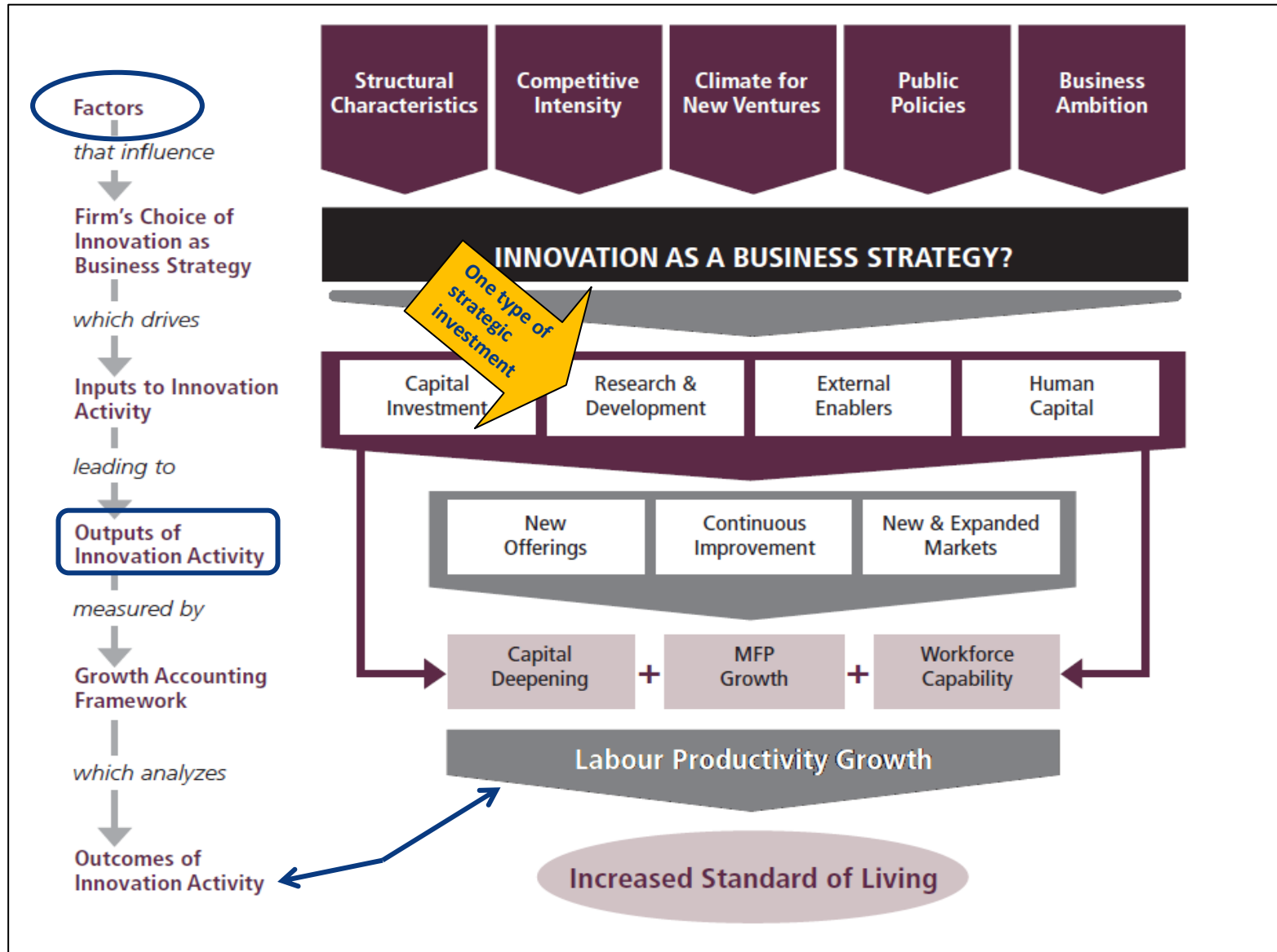
The relationship

- holds for GDP/capita, even is a bit stronger
- holds with alternative PPP (2008 EKS \$), but is a bit weaker

Source: The Conference Board (2009)



# Logic Map of the Business Innovation Process



Source: Canadian Expert Panel on Innovation, 2009.

# Outline of presentation

- Illustration of the issue
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- **Microeconomic perspectives**
  - Microdata literature on productivity and innovation is extensive...
  - ... and we currently have a rich understanding of key actors and institutions in the innovation system (role of young and small firms, churning among established firms)

# The Black Box of Intangibles...

the innovation process *within* established firms

....its drivers, its outcomes, and factors  
determining success

## Keys

- Measurement of firm-level outcomes (mandel #2)
  - ◆ ... but adding a product class for “blueprints” not enough, need classification system and unit of analysis
- Resolution of “Widget” vs. “Biz” views of the innovation process

# Let us first ask, What is innovation?

- “Innovation encompasses but is more than research and development” (NAS 2005).
  - ◆ Schumpeterian view: Involves more than invention, object is to make profits (1912).
  - ◆ Recent lit review: Common thread in all approaches is “the extraction of **economic value** from novel activities” (IVS project 2007)
  - ◆ Report of the Advisory Committee to the U.S. Secretary of Commerce (2008): a process whereby organizations put something new to commercial use or financial gain.
  
- Innovations may be technological or non-technological.

# Compare 2 studies from different literatures that propose a process for innovation

## Case 1. Advanced technology products

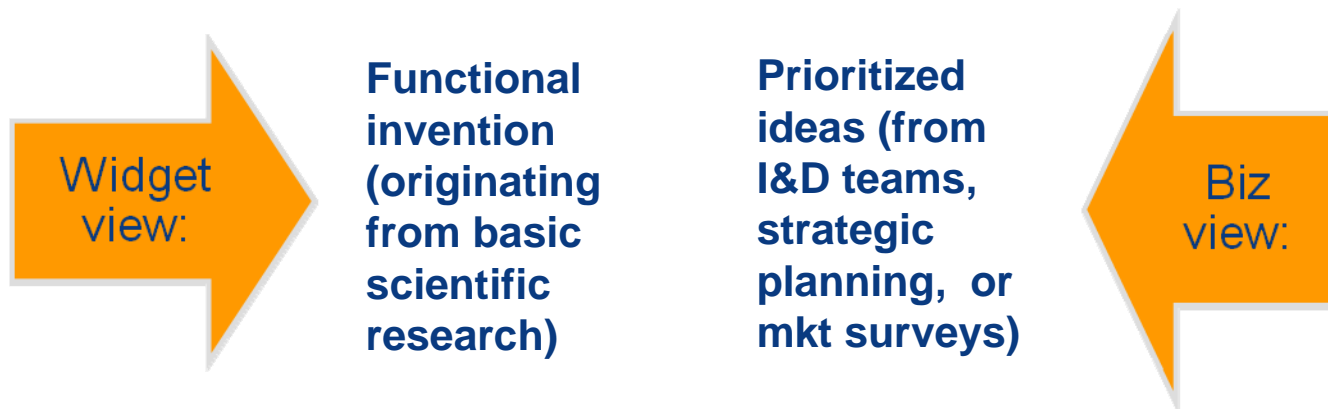
*Between Invention and Innovation: An Analysis of Funding for Early Stage Technology Development* by Lewis Branscomb and Philip Auerwald. *NIST GCR 02-841*. 2002.

## Case 2. Service delivery system

“R&D comes to Services: Bank of America’s Pathbreaking Experiments” by Stefan Thomke, *Harvard Business Review*, April 2003.

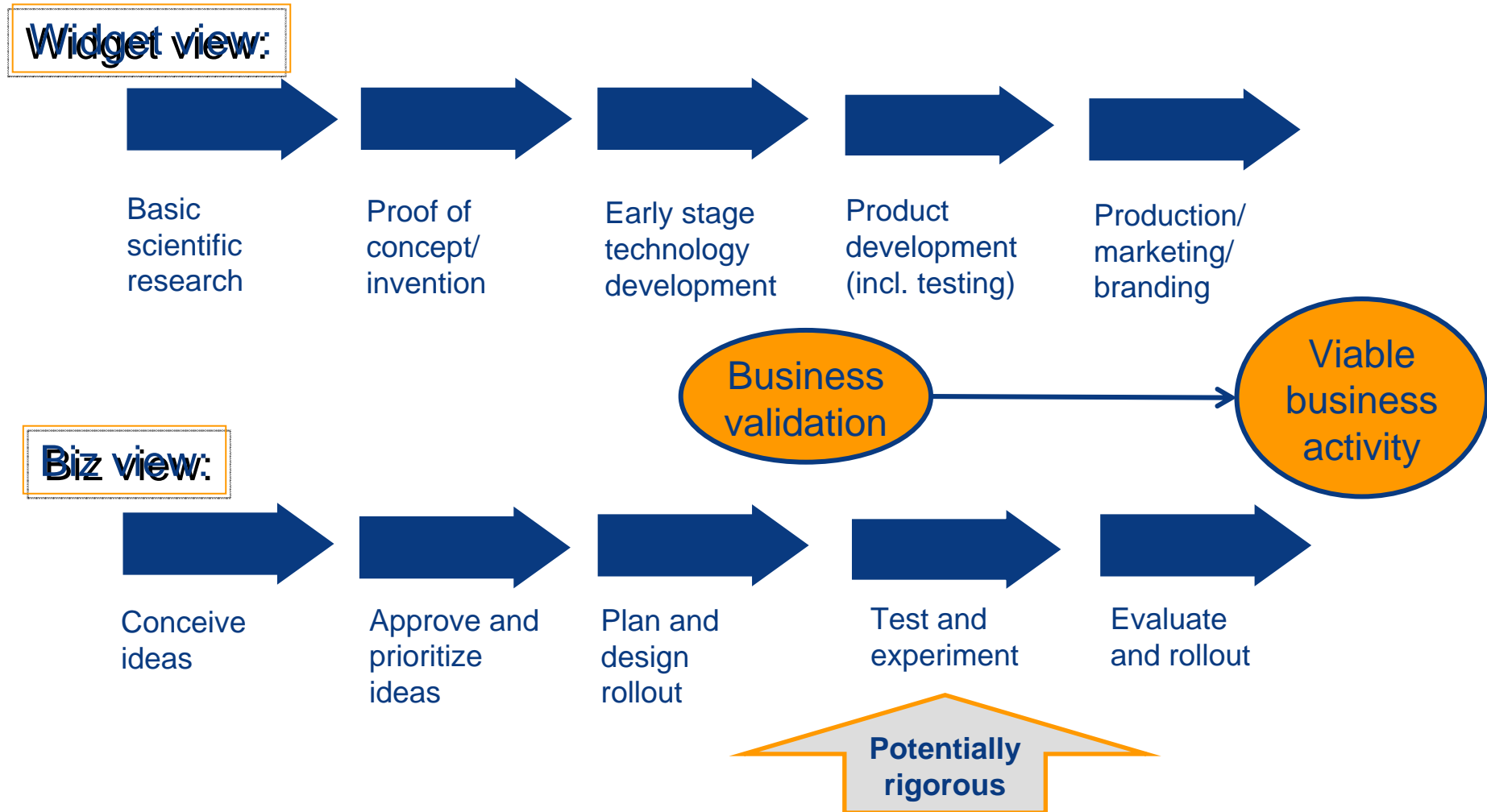
# Widgets and Biz: major research experience is with different aspects of the innovation process?

- Let's look at the business innovation process *after*
  - ◆ the discovery of a functional invention (proof of concept)
  - ◆ or the identification of a workable business idea



- Why? to concentrate on what technological and nontechnological innovations have in common -- **commercialization of an idea or invention**

# Stages of the innovation process from business validation on are fairly similar



# Intangible assets are about how knowledge and ideas are appropriated as innovation in modern firms

For our understanding to evolve, new data on innovation are needed:

- An important first step: a **classification** scheme for different **types of innovation**, including characteristics or key features of each type.
  - ◆ A recent typology of typologies (Chandy and Prabhu 2009) cuts across disciplines and provides a rigorous approach.
- The next step is to identify a **unit of analysis** for measurement: identifying instances of innovation within as “projects” may yield the needed data on innovation outcomes
  - ◆ For further explanation and key research questions, see Corrado and Lane (2009) in Session 6 of CAED.



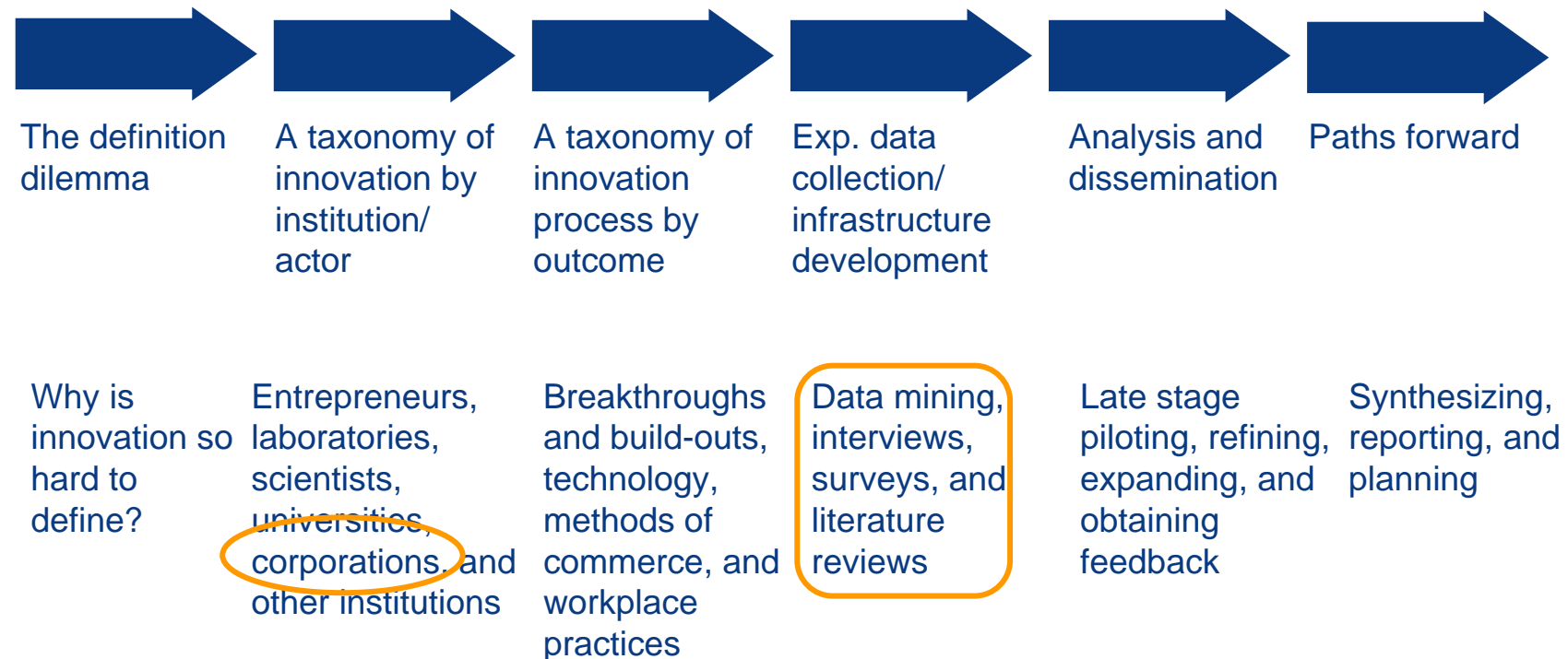
## Why these steps are important

- **Productivity** of resources devoted to innovation (esp., productivity by *type* of innovation) remains a black box.
- **Prevalence** of innovation by type (and driver) is a black box.
- Existing “policy” literature on the microeconomic environment of innovation is richly nuanced and textured, but in need of richer data!

### But remember,

- We’ve come a long way on defining innovation (Biz view is complementary, not contrary, to Widget view)
- We have a much greater understanding of the roles and characteristics of some key actors (institutions, scientists)

# Engaging the topic in a productive manner .... recap and further thoughts on next steps



- Thank you.
- References provided upon request:  
[carol.corrado@conference-board.org](mailto:carol.corrado@conference-board.org)
- Back up slides follow.

## Measurement requires a unit of analysis

- Instances of innovation processes within organizations are “projects.”
- At a recent NSF-sponsored workshop, there was broad agreement that the project level would appear to be the “unit of innovation” within organizations.
- For further explanation and key questions, see Corrado and Lane (2009) in Session 6 of CAED.

## Data collection **modalities** are greater than in the past b/c of advances in computer science (e.g., semantic web)

- Again, see Corrado and Lane in Session 6 of CAED for a description of some rich possibilities
- Examples (not directly related to innovation):
  - The Conference Board’s help wanted online data—collected via scraping the web! *Very detailed.*
  - Case study, “the last great American cell phone plant?” in Byrne and Corrado (2009), collected from internet archives.

## The last great American cell phone plant?

### **1991**

Nokia begins its first U.S. manufacturing operation at the Diplomacy Road/Centreport facility in Fort Worth.

### **1995**

Nokia begins operations at second Fort Worth plant in the Alliance industrial park.

### **1999**

The Alliance facility produces “1 million phones every 9 days” or perhaps \$5B in yearly shipments and 10 percent of world production (assuming year-round weekday operation and the TIA-reported 1999 average wholesale price of \$180).

Nokia and component suppliers occupy about 1 million square feet at the facility, making it “the largest mobile phone manufacturing operation in the world.” Half of the space is occupied by the suppliers, including makers of plastic injection molds and metalized protectorants.

“If a consumer buys a Nokia phone in the United States, it came from Fort Worth.” Employment peaks at 3,500.

### **2001**

Nokia lays off 800 workers. Diplomacy Road/Centreport is eliminated. Some U.S. mobile phone manufacturing moved to Mexico and Korea.

“The Alliance factory will be focused more on engineering support for the Americas and fulfillment for the U.S. market, but will continue manufacturing mobile phones.”

### **2002**

Nokia lays off 625 workers.

### **2005**

“Nokia will transition its high-volume, final assembly processes to its other production facilities and transform the Alliance facility into a customization and logistics center.”

350 workers laid off, reducing payroll to 950.

### **2007**

Nokia ceases operations in “late spring.”

At the end, “the Alliance facility focused on short lead-time logistics for customers requiring three days or less turnaround.” U.S. market is completely supplied by facilities in Mexico and Brazil.

In November, Nokia sells the plant back to the developer of the industrial park.

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1999: World's largest cell phone operation

... half of Industrial Park is suppliers (plastics, metals)

Nokia and component suppliers occupy about 1/2 of the Alliance industrial park, the largest mobile phone manufacturing operation in the world." Half of the space is occupied by the suppliers, including makers of plastic injection molds and metalized protectorants.

"If a consumer buys a Nokia phone in the United States, it came from Fort Worth." Employment peaks at 3,500.

### 2001

Nokia lays off 800 workers. Diplomacy Road/Centreport is eliminated. Some U.S. mobile phone manufacturing moved to Mexico.

2001: Company shifts focus to engineering and marketing

"The company focuses on engineering and marketing in the Americas and fulfillment for the U.S. market, but manufacturing is moved to Mexico."

### 2002

Nokia lays off 625 workers.

### 2005

2005: ...to customization and logistics

"Nokia will transition its high-volume, high-volume manufacturing to Mexico and transform the Alliance facility into a customization and logistics center." 350 workers laid off, reducing payroll to 950.

### 2007

Nokia ceases operations in "late spring."

At the end, "the Alliance facility focused on short lead-time logistics for customers requiring three days or less turnaround." U.S. market is completely supplied by facilities in Mexico and Brazil.

2007: ... to nothing

In November, Nokia sells the plant back to the developer of the industrial park.