Studying the Structure and Dynamics of Business Ecosystems

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Typical Context for Innovation

“In this paper, we focus on the problem of product development, taking as the unit of analysis a manufactured product sold to an end user and designed, engineered, and manufactured by a single product-development organization.” (Henderson and Clark, 1990)

Useful representation when innovation is isolated within the firm and/or the user

This assumption is becoming increasingly problematic as firms are becoming more specialized and technologies more complex.
### Shift in the Computer Industry

**Computer Industry (1980)**
- **sales & distribution**
- **application software**
- **operating system**
- **computer**
- **chips**

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<th>IBM</th>
<th>DEC</th>
<th>Sperry Univac</th>
<th>Wang</th>
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**Computer Ecosystem (1995)**
- **sales & distribution**
- **application software**
- **operating system**
- **computer**
- **chips**

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<th>Retail Stores</th>
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<th>Mail Order</th>
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<td>DOS and Windows</td>
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<td>Mac</td>
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<td>UNIX</td>
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<td>Packard Bell</td>
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<td>Intel Architecture</td>
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<td>Motorola</td>
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<td>RISC</td>
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**Source:** Andrew Grove, *Only the Paranoid Survive* (1996)
Context for Innovation: System of Interdependent Activities/Technologies

Suppliers

Complementors

Innovation

Market

Firm

User

Innovation

C1

C2

S1

S2

S3

C1

C2
Electric Cars Ecosystem

- Battery Makers
- Electric Motor Suppliers
- General Suppliers
- Auto Firms
- Utilities
- Charging Stations
- Dealers
- Consumer
- Garages
Semiconductor Manufacturing Ecosystem

- **Semiconductor Manufacturer**
  - Mentor Synopsys
  - Applied Materials
  - ASML
  - Nikon
  - KLA-Tencor
  - Photronics
  - Toppan
  - Shipley
  - JSR

- **EDA Software**
  - Mentor
  - Synopsys

- **Lithography Equipment**
  - ASML
  - Nikon

- **Metrology Equipment**
  - KLA-Tencor

- **Mask**
  - Photronics
  - Toppan

- **Resist**
  - Shipley
  - JSR

- **Lasers**
  - Cymer

- **Lens /Optics**
  - Zeiss

- **Research Institutes/Labs**
  - IBM
  - Intel
  - Samsung
  - TSMC
  - Sandia
  - Fraunhofer

- **Consortia**
  - SEMATECH
  - ASET
  - SELETE

- **Universities**
Explicit Recognition of Technological Interdependencies: Not New!

• Business History
  - System-based view of technology
  - Rich description of evolutionary processes

• IO Economics
  - Standards/Network Effects/Two-sided markets
  - Pricing as a primary firm-level “lever” to manage interdependencies

• Org. Sociology
  - Social construction of technology
  - Social groups, identity, legitimacy as shaping tech. evolution

• Strategy
  - Complementary assets
  - Firm’s value appropriation through specialized comp. assets
  - Focus on firm-level value chain (manufacturing, marketing, distribution)
Opportunities for Strategy Scholars (That I have Benefitted From!)

• Firm Boundaries
  - Emphasis has been on dyadic buyer-supplier interactions
  - Opportunities to explicitly consider:
    • Complementors
    • System-level interdependencies
Complementors and Firm Boundaries

(Kapoor and Lee, 2013)
Unpacking Different Types of Complementarities
Existing Approach

- Complement is a “number”
- The more complements (number and variety) the better for the platform
- No difference between phone, browser, map and Angry Birds
Different Types of Interdependence

- **Two-way interdependence**
  
  *Both goods are essential for creating value*
  
  - Razor and Blade
  - Wireless Handset and Mobile Operating System

- **One-way interdependence**
  
  *One good is essential for the other to create value but not vice versa*
  
  - TV and DVR
  - Social Networking and Social Gaming
Look Beyond Dyads to Identify System-level Effects
Complementarities in the Smartphone Ecosystem

(Chatain and Kapoor, 2013)
More Opportunities

• Industry Evolution
  - *Emphasis has been on describing changes over the industry life cycle (entry, exit, #firms, innovative activity) and performance differences based on when firms entered the industry*
  - *Opportunities to explicitly consider different types of firms (suppliers, complementors, integrated, specialized etc.)*
  - *Distribution of value among actors over time*
Evolution of Global Semiconductor Industry

Number of Firms

- 1984
- 1986
- 1988
- 1990
- 1992
- 1994
- 1996
- 1998
- 2000
- 2002
- 2004
- 2006
- 2008

- 50
- 70
- 90
- 110
- 130
- 150
- 170
- 190
- 210
- 230
- 250

Rahul Kapoor, AOM 2013 PDW on Business Ecosystems
From Semiconductor Industry to Semiconductor Ecosystem

Pre-1980

Systemic Innovation

| Design (Autonomous Innovation) | Manufacturing (Autonomous Innovation) | Marketing & Sales |

Post-2000

Systemic Innovation

| Design (Autonomous Innovation) | Manufacturing (Autonomous Innovation) | Marketing & Sales |

IDM Firms

Foundry Firms

Fabless Firms

(Kapoor, 2013)
Number of Entrants in the Global Solar PV Industry

(Kapoor and Furr, 2013)
Entry in the Global Solar PV Industry

- Entrants pursued four distinct technology choices
- Technologies differed in performance at the time of entry
Technologies also differed in the extent to which the key complementary technologies were available at the time of entry.
Main Findings

• Entrants into emerging industries face a trade-off between technology superiority and the availability of complementary technologies

• Diversifying entrants are more likely to trade-off technology superiority for the availability of complementary technologies

• Start-up entrants are more likely to trade-off the availability of complementary technologies for technology superiority
Even More Opportunities

• Technology Transitions
  - *Emphasis has been on focal technology/firms (incumbents vs. entrants)*
  - *Opportunities to explicitly consider:*
    - System-level technology dynamics (e.g., technological bottlenecks; component vs. architectural changes)
    - Performance for different types of firms in the system
With Opportunities Come Challenges

Novelty Challenges (for Strategy crowd)

- How is this different from literatures on alliances, buyer-supplier relationships, networks, network effects, population ecology, firm boundaries?
- What are the unique concepts and causal mechanisms?

Empirical Challenges

- High level of contextual knowledge
- Data requirements are significantly broader
  - Publicly available archival datasets not adequate

Theoretical Challenges

- Ecosystems have many transactions, different types of firms and a number of interconnected industries
- Leveraging prior work on different units of analysis (transaction, firm and industry)
Addressing Challenges

• Leveraging the Ecosystem - greater collaboration within the research community
  
  Complementarities in theories, methods and data

• Leveraging new developments in:
  
  ➢ Mathematics (e.g., graph theory)
  
  ➢ Complex systems (not just an evolutionary process but the one which has a role for “Strategy”)
  
  ➢ Other fields??

• Dedicated avenues (conferences/workshops) for discussing and developing new ideas

• Special Issue in SMJ or Strategy Science
Thank You