Session 6: Standards, Modularity and Strategy
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Standards and Strategy

- Cusumano, M. A., Mylonadis, Y., & Rosenbloom, R. S. (1992)
  - Beta vs. VHS
- Shapiro, C., & Varian, H. R. (1999)
  - The art of standards wars

Modularity and Innovation

  - Managing in an age of modularity
- Fleming, L., & Sorenson, O. (2001)
  - The dangers of modularity

Empirical studies: Strategic alliance and R&D procurement strategies

  - An investigation of strategic alliance formation
- Pisano, G. P. (1990)
  - The R&D boundaries of the firm
Dominant Design and Standards

The emergence of a dominant paradigm signals scientific maturity and the acceptance of agreed upon “standards” by which what has been referred to as “normal” scientific research can proceed. These “standards” remain in force unless or until the paradigm is overturned. Revolutionary science is what overcomes the limits to the standards.

Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy

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Final version received June 1986
Significance of Standards: QWERTY vs Dvorak

Fig. 1. Sholes QWERTY keyboard and typebasked 1873.

Fig. 3. The 1936 Dvorak Patent.

Clio and the Economics of QWERTY

Paul A. David

01 Strategic Maneuvering and Mass-Market Dynamics: The Triumph of VHS over Beta
Cusumano, M. A., Mylonadis, Y., & Rosenbloom, R. S.
The Art of Standards Wars
Shapiro, C., & Varian, H. R.

Your ability to successfully wage a standards war depends on your ownership of seven key assets:

- control over an installed base of users;
- intellectual property rights;
- ability to innovate;
- first-mover advantages;
- manufacturing capabilities;
- strength in complements; and
- brand name and reputation.

North vs. South in Railroad Gauges

Edison vs. Westinghouse in Electric Power:
The Battle of the Systems

RCA vs. CBS in Color Television

Preemption

Expectations Management
## The Art of Standards Wars

### Historical examples

- North vs. South in Railroad Gauges
- Edison vs. Westinghouse
- RCA vs. CBS in Color TV

### Strengths in the standards games

- Control of an installed base
- IPR
- Innovation
- First-mover advantages
- Manufacturing abilities
- Presence in complementary products
- Brand name and reputation

### Strategies

- Alliance
- Preemption
- Expectations Management
Coordination versus differentiation in a standards war: 56K modems

Angelique Augereau*
Shane Greenstein**
and
Marc Rysman***

The Political Economy of Standards Coalitions: Explaining China’s Involvement in High-Tech Standards Wars

Scott Kennedy

A standards war waged by a developing country: Understanding international standard setting from the actor-network perspective

Heejin Lee a,*, Sangjo Oh b
## Discussion – Standards, Innovation and Strategy

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<th>DEVELOPMENT</th>
<th>INTRODUCTION</th>
<th>GROWTH</th>
<th>MATURITY</th>
<th>DECLINE</th>
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</thead>
<tbody>
<tr>
<td>Standards development premature in very early stages</td>
<td>Quality &amp; function standards for acceptance</td>
<td>Standards for Quality and Reliability</td>
<td>Standards for interoperability</td>
<td>Use standards for reduced costs</td>
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<tr>
<td>Use regulatory standards during design</td>
<td>Standards for Compatibility</td>
<td>Standards for royalties and to differentiate from competing products</td>
<td>Develop new standards to focus development and for variety reduction</td>
<td>Variety reduction (new standards)</td>
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<td>Initiate standards development to prevent investment in wrong standard</td>
<td>Variety reduction (existing standards)</td>
<td>IPR for incremental developments</td>
<td>Licensing for royalties, to solve disputes, and to develop products</td>
<td>Full product standard</td>
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<td>Use standards and IPR to determine the state of the art</td>
<td>Branding – trademarks</td>
<td>Registered design for development</td>
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<td>Develop standards to focus product development</td>
<td>Dissemination via IPR and standards</td>
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<td>Make patent decisions while still secret</td>
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<td>Dissemination via IPR and standards</td>
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<td>Ensure proof of copyright</td>
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<td>Apply for registered design</td>
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<td>Recognize and protect IP and enforce IPRs</td>
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<td>Search IPR records for partners and employees</td>
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<td>Check competitor’s activity</td>
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<tr>
<td>Avoid or license other’s IPR</td>
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<tr>
<td>Market identification – influence a standard or define a new one?</td>
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<td>Which standards can be used for faster design?</td>
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<td>Does the product need to be interoperable, portable, or compliant with existing standards?</td>
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Source: Clarke, 2004
Modularity and Innovation

Figure 1. A framework for defining innovation.

<table>
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<tr>
<th>Core Concepts</th>
<th>Reinforced</th>
<th>Overturned</th>
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<tbody>
<tr>
<td>Unchanged</td>
<td>Incremental Innovation</td>
<td>Modular Innovation</td>
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<tr>
<td>Changed</td>
<td>Architectural Innovation</td>
<td>Radical Innovation</td>
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Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms

Rebecca M. Henderson
Massachusetts Institute of Technology

Kim B. Clark
Harvard University
00 Modular vs Integrated

Fig. 4. Four trailer architectures.

Fig. 5. Four desk architectures.

The role of product architecture in the manufacturing firm

Karl Ulrich *
Managing in an Age of Modularity
Baldwin, C. Y., & Clark, K. B.

Modularity is a strategy for organizing complex products and processes efficiently. A modular system is composed of units (or modules) that are designed independently but still function as an integrated whole. Designers achieve modularity by partitioning information into visible design rules and hidden design parameters. Modularity is beneficial only if the partition is precise, unambiguous, and complete.

A growing number of industries are poised to extend modularity from the production process to the design stage.

Following Intel and Microsoft, it’s tempting to say companies should control the visible rules.

Architect: advantage comes from attracting module designers to its design rules

Module maker: advantage comes from mastering the hidden info of the design and from superior execution in bringing its module to market.
## The Dangers of Modularity
Lee Fleming and Olav Sorenson

<table>
<thead>
<tr>
<th>Modular design</th>
<th>Integrated design</th>
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<tbody>
<tr>
<td><img src="image1" alt="Modular Design Example" /></td>
<td><img src="image2" alt="Integrated Design Example" /></td>
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</tbody>
</table>

- Mount Fuji
- NPD process is more predictable
- Imitation by competitors

- Alps
- High interdependence
- High risk, high return

- Intermediate levels of interdependence produce the most useful inventions.
- Changing the modularity of component is one way to alter a technological terrain.
Discussion – PLC and integrated/modular approach

Causality shifting competitive advantage in a given tier of a market from integrated firm

Region A → Region B

1) Shift of trajectories of improvement.

2) Compete in different dimensions (speed, flexibility and customization).

3) Modularity enables independent, focused providers of individual pieces of value-added to thrive.

Christensen, Verlinden and Westeman (2002), Disruption, disintegration and the dissipation of differentiability.
Question: Then, is it always the case that along with PLC, Region B (modularity) always disrupt sustaining technology and migrate profit? Is there any possibility that modular product evolves into integrated product?
Discussion – PLC and integrated/modular approach

Shimano integration
Network positions and propensities to collaborate
Toby E. Stuart

Importance of strategic alliance

• In high-technology sectors, alliances appear to have become a routine strategic initiative.
• Empirical studies produced evidence that alliances affect corporate performance.

Research objective / question

• Propose a positional explanation of the phenomenon.
• Investigated whether technological similarities and prestige distinctions among the firms in a focal industry affect horizontal alliance formation within the market.
• How does a producer’s position in the market affect its propensity to enter into strategic coalitions?

Technological positioning

• Heterogeneities in the technological positions of producers can complement and extend our understanding of alliance antecedents.
• It influences whether, when, and to what extent firms have opportunities to establish alliances.
Network positions and propensities to collaborate
Toby E. Stuart

Technological positioning: Crowding & Prestige

Crowding
Degree to which the technological focus of a firm is shared by others.

- Duplication avoidance
- Collusion
- Absorptive capacity
- Presence in the center of Mkt.

Prestige
Achievement of seminal innovation in technology market.

- Number of partners available
- Attention and status conveyed
- Superior bargaining position

Figure 1. Dispersion of semiconductor firms in technology space in 1991.
Result & Implication

• There is a demographic component to alliance formations.
• Position of a firm in a broader technological context is one factor that influences alliance formation rates. → Not everybody can form strategic alliance!
• Prestige overwhelmed sales revenue in its effect on alliance formation.
• Technological positioning is sure to change over time as a result of the pattern of technology alliance formation in an industry.
Importance of R&D Procurement decision

• R&D procurement decisions are relevant for *established* enterprises confronting broad and rapid changes in their core technologies.

→ creative destruction (Schumpeter), established firms’ in-house laboratories may lack the relevant technological skills to perform R&D competitively with new entrants.

Objective

• Develops and tests transaction-cost hypotheses for R&D procurement at the project-level.

| Engineering intensity and design specialization |  |
| Technological uncertainty |  |
| Co-location of specialized assets |  |
| Small-numbers bargaining hazards stemming from specialized R&D capabilities | ★ |
| Appropriability problems arising from competition in product market | ★ |
Two types of contractual hazards

**Small-numbers bargaining**

- Know-how being procured is specialized to the supplier.
- Difficult in finding or switching partners for future projects aimed at the same product application area.
- Provide an incentive for internalization.

**Appropriability problems**

- When the project is done externally, the restriction must be incorporated into the contractual agreement.
- Inability to define or enforce intellectual property rights creates a hazard of expropriation. \( \Rightarrow \) # of rivals.
### Structure of competition

How the structure of competition between new entrants and established firms may evolve in the wake of technological change.

<table>
<thead>
<tr>
<th>Competition</th>
<th>Established firms</th>
<th>New entrants</th>
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</table>
| Distinctive advantage in marketing and distribution. | Develop new R&D technology. | Adopting new R&D and production skills to compete.  
\[ Ability to build capabilities in commercial activities, ability to acquire and develop new R&D skills. \] |

| Cooperation | Procure some R&D projects from external sources and to focus internal resources on those functions such as marketing.  
\[ Ability to select partners and manage cooperative relationships. \] |  |
Discussion – Impacts of Strong/Weak Appropriability Regimes and Modular/Integrated Approach on Alliance and R&D Strategy

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Disruption, disintegration and the dissipation of differentiability

Clayton M. Christensen, Matt Verlinden and George Westerman