# 15.912 Technology Strategy

Fall 2008

# Intel Photolithography and Effective Organization of R&D

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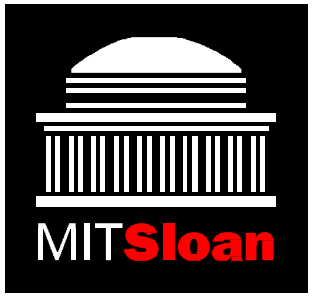


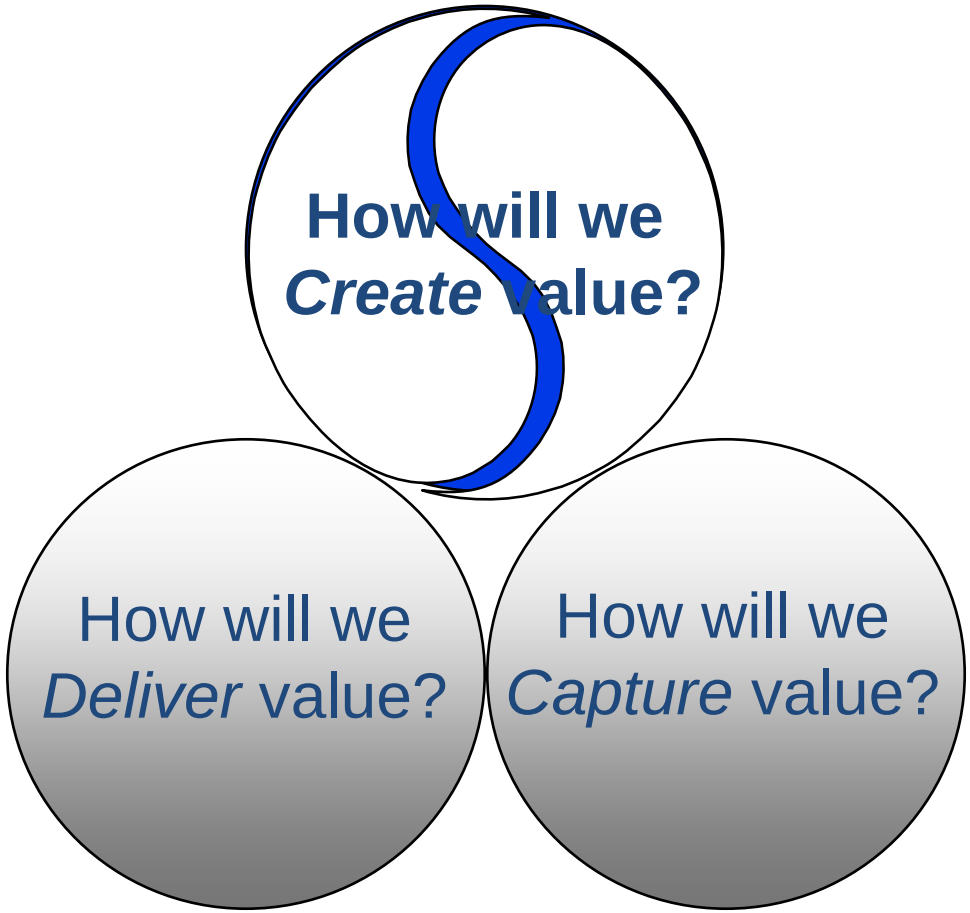
# Intel Photolithography Update (1)

- Wilson develops the Consortium option:
  - Resolves Free Rider problem with a complicated business model: "Virtual National Lab" VNL organized:
    - EUV LLC company manages research; holds all IP
    - Lawrence Livermore + Sandia + Lawrence Berkeley labs run it
      - ~150-170 people working on EUV
    - Intel (12-15p; $50m); Motorola (6-8p; $10m); AMD (2p;$5m)
      - Bought shares in EUV LLC
    - Equipment manufacturers (Nikon and Canon) purchased rights of first refusal with guaranteed margins to convince them to make photolithography equipment.

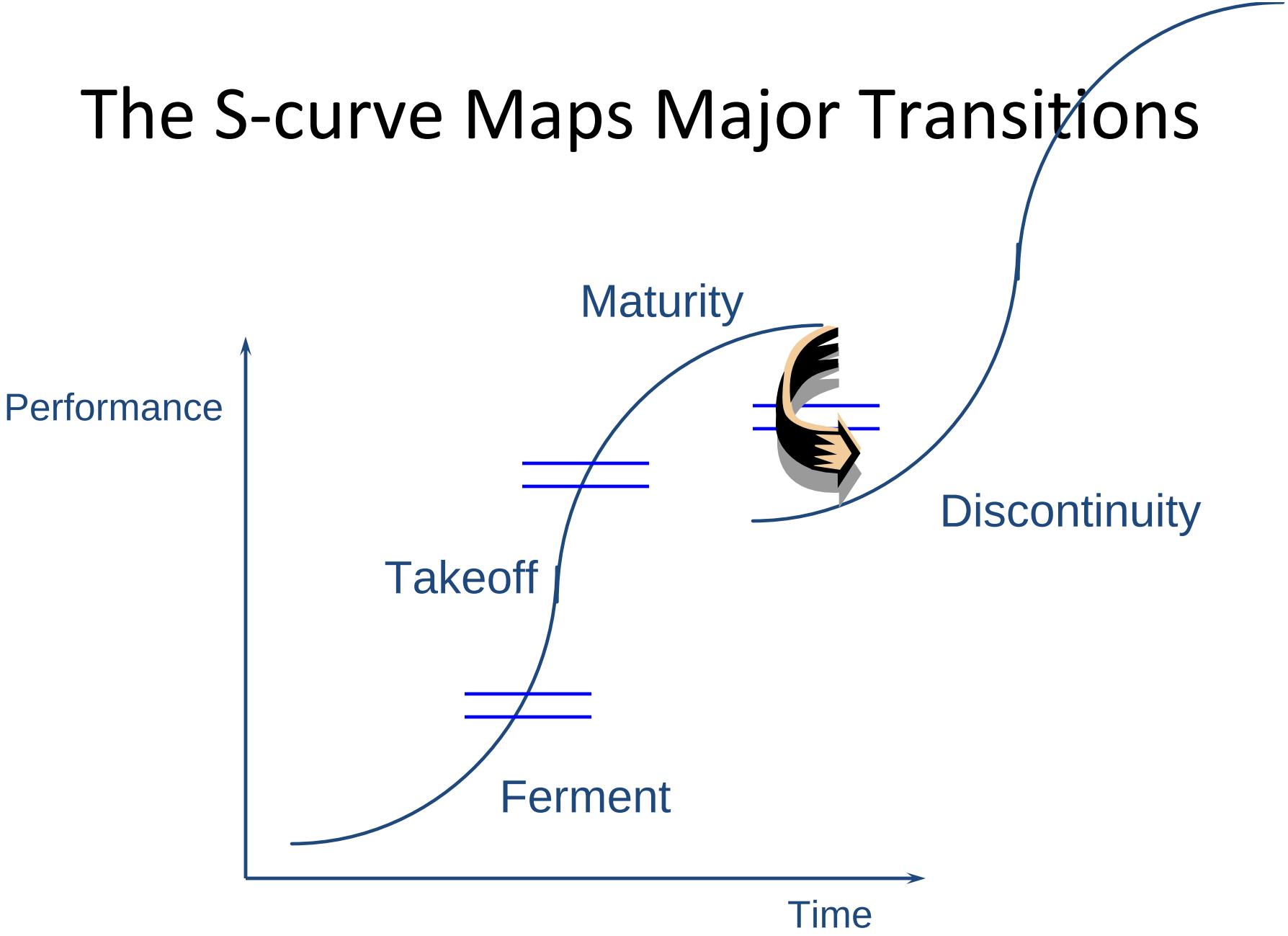
# Intel Photolithography Update (2)

- Problems emerge for EUV LLC:
  - Congress steps in to limit foreign companies value capture…EUV LLC forced to create incentives for domestic companies
  - By 2006, technical progress on 45-nm EUV faces major problems including power issues.
  - Intel pushes EUV back from 2008 (now!) to 2011 on Roadmaps…extends optical technologies with “computational” tricks to correct errors that are smaller than wavelength of light.

# Value Creation: Technology, Markets, and Organizations



# The S-curve Maps Major Transitions

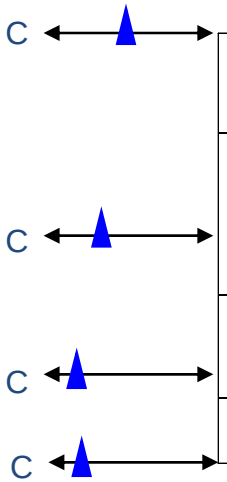


# Novartis Pharmaceuticals: Organizational design reflects research topic synergies

## Summary

Centralizing R&D permits Novartis to focus resources on common, underlying research topics. The Novartis corporate senior leadership has traditionally been very technologically oriented (PhD/MD) and drives the company to develop new blockbusters. Novartis acquires product rights from biotech firms to plug gaps in their offering.

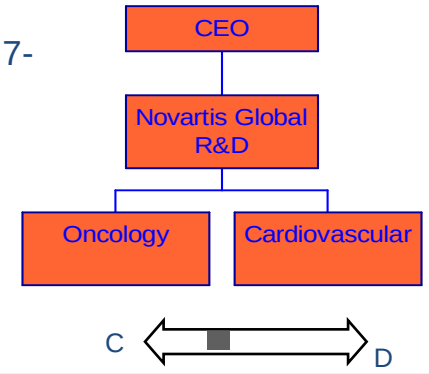
## Situation




| | |
|---|---|
| **Technology** | • Academia leads fundamental research in understanding disease mechanism<br>• Industry labs identify therapeutic targets based on basic science of disease mechanism<br>• Patents of composition provide strong competitive insulation for a single molecule product |
| **Market and Strategy** | • Range of easily exploitable business opportunities is narrowing while the range of radical new approaches (e.g. genomics) is expanding rapidly<br>• Pharma industry is driven by blockbuster products anticipated by street visibility through a 10 year pipeline<br>• Novartis portfolio decision-making bodies include business unit representation |
| **Organizational Context** | • Need high critical mass of researchers to advance the common scientific platforms supportin multiple product categories<br>▪ Early stage product development teams are highly cross-functional |
| **Leadership** | • Corporate leadership is highly technical and closely involved with the research programs and development projects. |

## Structure

- Fully centralized research that supports 7-10 therapeutic area businesses
- Scientific platforms support multiple therapeutic areas (e.g. immunology)




## Relevance

- Novartis and other major pharma companies spend 15-20% of sales on R&D to discover and develop “blockbuster” products
- Centralized R&D provides critical mass of specialized expertise and facilities to leverage science across multiple product categories
- To offset the potential disconnect between R&D and business, Novartis deploys research review including senior business, development and manufacturing representatives.

# Intel: Decentralized R&D structure reflects availability of externally-available technology plus a strategic lock on industry standards

## Summary

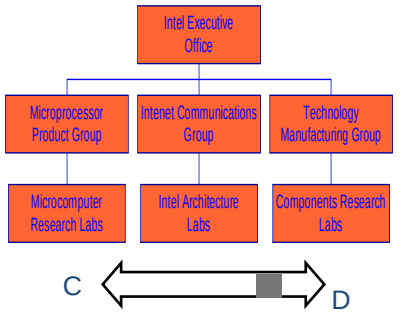
Intel's strategy is distinct among semiconductor makers: Intel exploits externally-led basic research, and concentrates on adapting it to get products to market quickly. Intel "free rides" on fundamental research from competitors such as such as Lucent and IBM. They set the rules of the game through their control of standards and architecture.

## Situation

| | |
|---|---|
| **Technology** | • Major technology advancements are acquired from external sources<br>• Product life cycles are very short<br>• As current generation technology approaches theoretical performance limits, search intensifies for radical new approaches |
| C ◄► D | • Technology is modular, but Intel has a strategic lock on architectural control |
| **Market and Strategy** | • Semiconductor industry is highly competitive and mature<br>• Intel competes on its ability to develop processes to bring products to market faster than competitors; flexible production lines allow very efficient variations on existing technology |
| C ◄► D | • Relies on industry consortium (Sematech) to advance manufacturing state of the art<br>• Emphasis on building strong brand equity to project product "premiumness" |
| **Organizational Context** | • High level of acquisition activity<br>• Strong ability to exploit both internal and external research |
| C ◄► D | • Places paramount importance on time-to-market issues associated with technology transfer |
| **Leadership** | • History of strong technological leadership from CEO (from DRAM chips to processors) |
| C ◄► D | |

## Structure

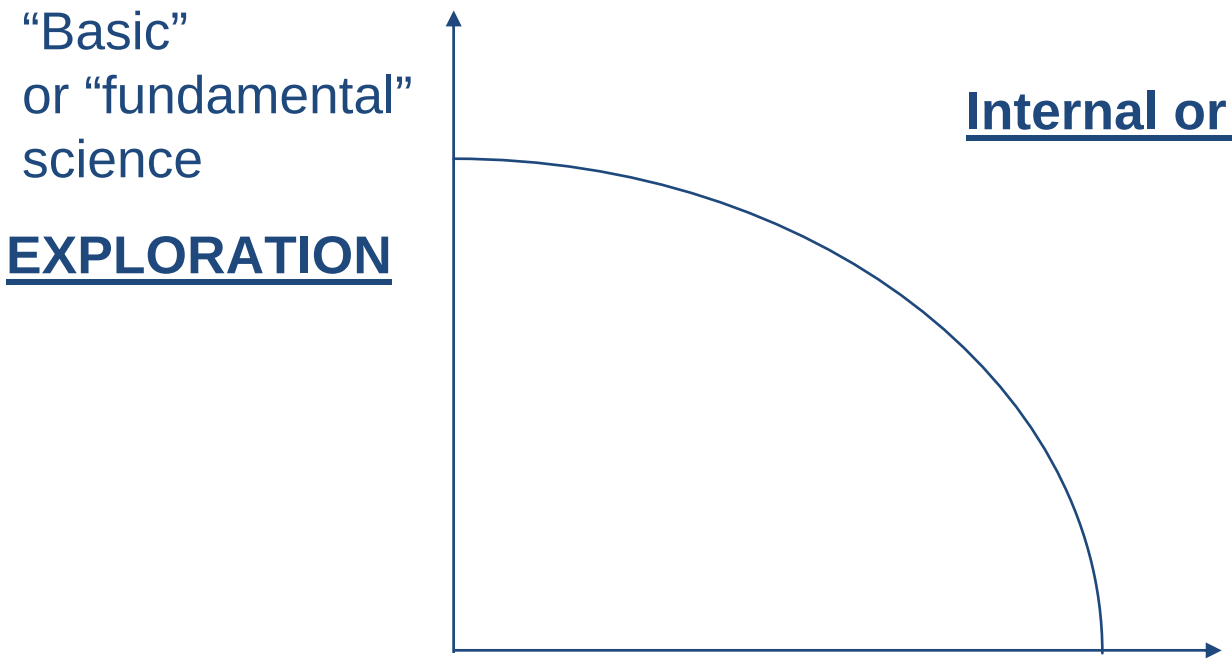
- Business-unit Decentralized R&D
- Technology Council coordinates research
- Architecture Labs conduct basic research to maintain dominance in setting industry standards and forecast future




## Relevance

- Intel relies on in-sourcing available technology through an Decentralized R&D structure.
- Intel is seldom first to invent, but are fast and efficient adapters
- This approach has yielded substantial profitability, but leaves them vulnerable to competitive technological advances.

# Current “best practice” attempts to balance & integrate the two poles:



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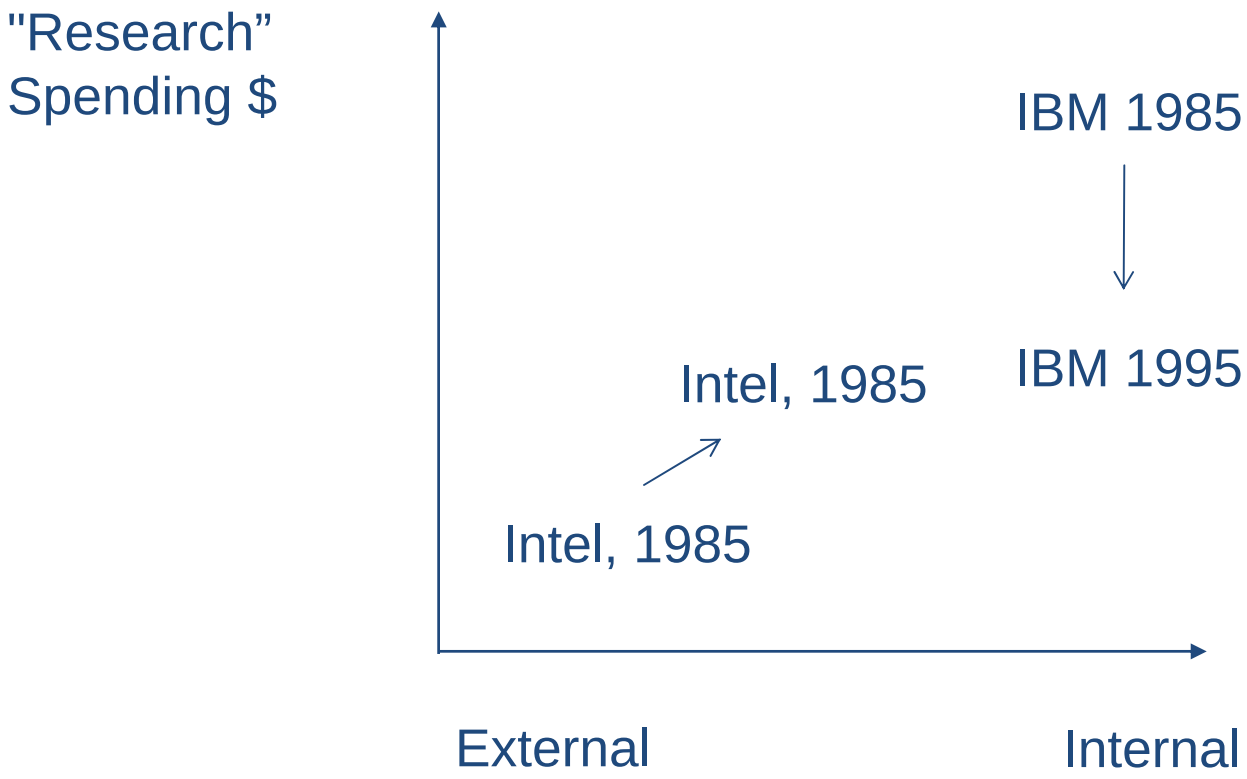

# Pharmaceuticals 1981-1997

**Pharmaceutical Firms: Relevant Patents vs Basic Research Publications, 1981-1997**

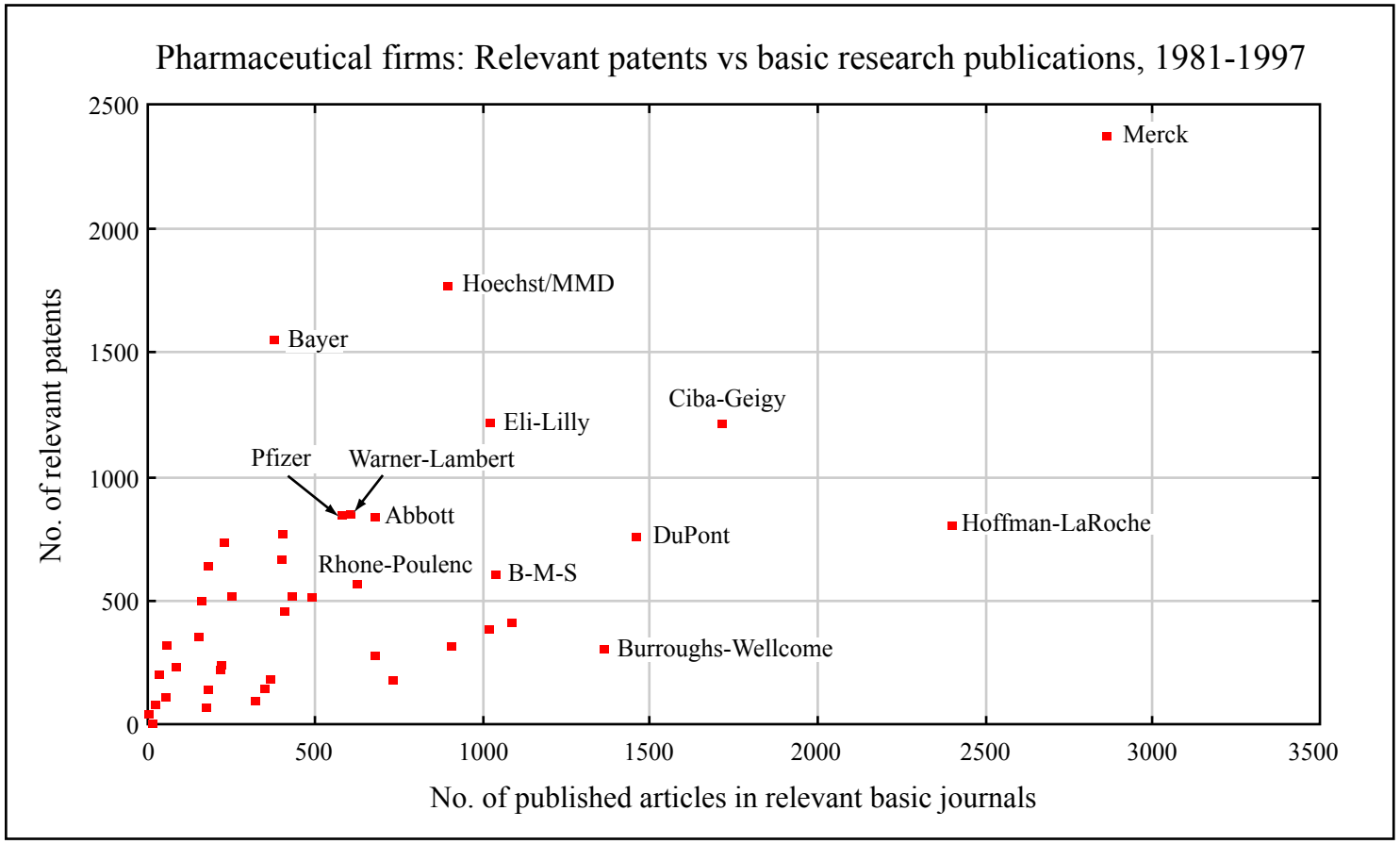


Image by MIT OpenCourseWare.

**Patents**

**Publications**

Source: Kwanghui Lim: "The Relationship between Research and Innovation in the Semiconductor and Pharmaceutical Industries: Implications for Theories of Knowledge Spillovers "

# Semiconductors 1981-1997

Patents

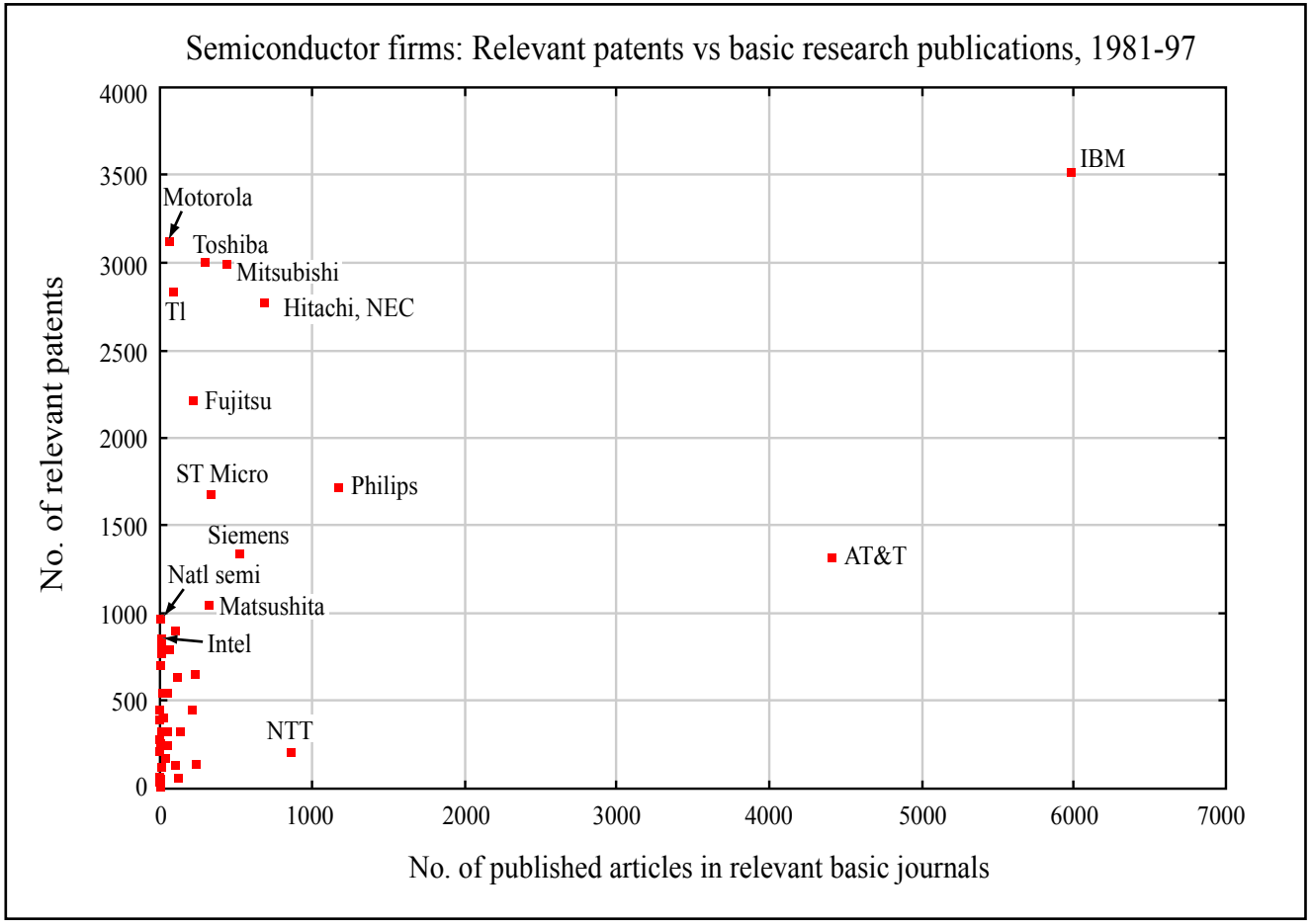


Image by MIT OpenCourseWare.

Publications

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# Intel Summary and Take-Aways

- Creating Value Often Requires Industry-wide Coordination
  - Technology Leaders can benefit by being first on S-curves and market diffusion curves
  - Free Rider Problems can emerge
- Tradeoffs between Value Creation and Value Capture can emerge
- Effective Organization Balances Exploration and Exploitation

# Looking Forward:

- S-curve papers handed back; most groups did well.
  - Grading focused on ways to create and destroy value.
- Reflections on Effective Organization:
  - Organization Structures:
    - Amount of Structure
    - Connectivity
    - Internal vs. External
  - Organization Processes:
    - Co-evolving
    - Exploration and Exploitation
    - Patching
  - Incentives:
    - High Power “entrepreneurial” incentives vs. Coordination