Architectural Innovation:

The Reconfiguration of Existing Product Technologies and the Failure of Established Firms

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Types of Technological Change

- Core concept
  - Reinforced & overturned
- Linkage between core concepts and components
  - Unchanged & changed

A Framework for Defining Innovation

- Incremental innovation
  - Large, electrically powered fans, mounted in the ceiling, with the motor hidden from view and insulated to dampen the noise
- Radical innovation
  - A move to central air condition
- Architectural innovation
  - Introduction of a portable fan
- Modular innovation
  - The replacement of analog with digital telephones

A Framework for Defining Innovation

Linkage between core concepts and components	Core concepts: Reinforced	Core concepts: Overturned
Unchanged	Incremental innovation	Modular innovation
Changed	Architectural innovation	Radical innovation

Example: Bike

Incremental innovation	Modular innovation
	
Architectural innovation	**Radical innovation**
	

Example: Camera

Incremental innovation	Modular innovation
	
Architectural innovation	**Radical innovation**
	

The Evolution of Component and Architectural Knowledge

- Two concepts are important to understand the ways in which component and architectural knowledge are managed inside an organization:
  - Dominant design
  - Organizations build knowledge and capability around the recurrent tasks that they perform

The Evolution of Component and Architectural Knowledge

- New technology evolves
  - Confusion, experimentation
  - Develop both knowledge about alternative configurations
  - Emergence of the dominant
  - Cease to invest in alternative configuration
    - New component knowledge is valuable.
    - Architectural knowledge is stable.

Channels, Filters, and Strategies

- Communication channels
  - Relationships around which the organization builds architectural knowledge.
  - An organization's communication channels will come to embody its architectural knowledge of the linkages between components.
- Information filters
  - The emergence of a dominant design and its gradual elaboration molds the organization's filters so that they come to embody parts of its knowledge of the key relationships between the components of the technology.
  - Information filters allow it to identify immediately what is most crucial in its information stream.

Channels, Filters, and Strategies

- Problem-solving strategies
  - An organization's problem-solving strategies summarize what it has learned about fruitful ways to solve problems in its immediate environment.
  - When confronted with a problem, engineer focuses on those alternatives he has found to be helpful in solving previous problems.

Channels, Filters, and Strategies

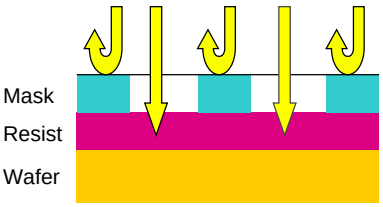
- Operation of channels, filters, and strategies becomes implicit in the organization.
  - Efficient
  - Using them becomes natural
- Architectural knowledge is to be managed implicitly by embedding it in their communication channels, information filters, and problem-solving strategies.
- Component knowledge is to be managed explicitly.

Problem Created by Architectural Innovation

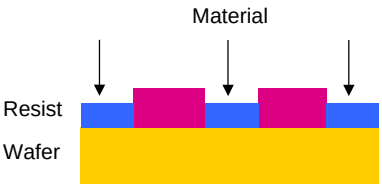
- Established organizations require significant time to identify a particular innovation as architectural.
  - The introduction of new linkages is much harder to spot
- The need to build and to apply new architectural knowledge effectively
  - It must switch to a new mode of learning and then invest time and resource in learning about new architecture.
    - Experience in switching
    - Build a new architectural knowledge
- New entrants
    - Easier to reorientation
    - Easier to build new architectural knowledge

What Is Photolithography ?

Step1: Expose resist



Step3: Deposit material

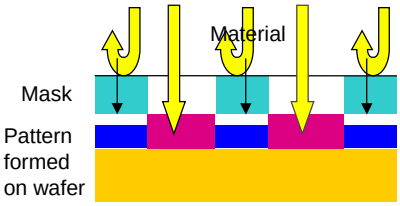


Step2: Develop resist

Step4: Remove remaining resist

Photolithography

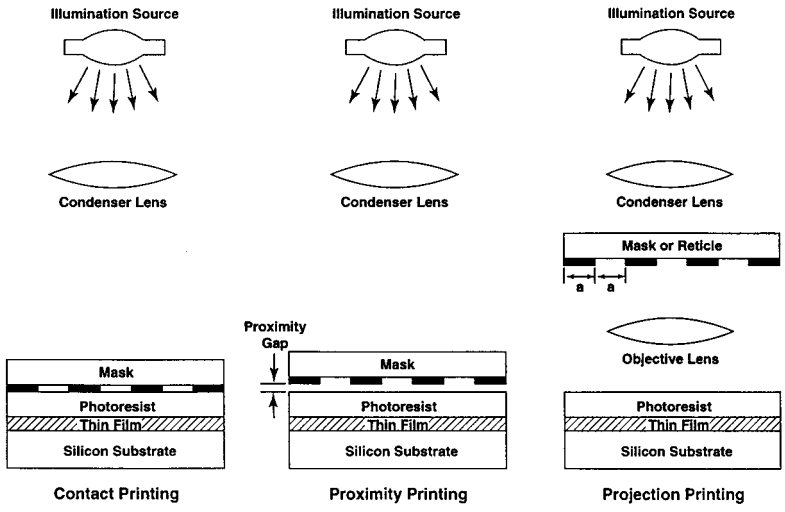
Step4: Remove remaining resist



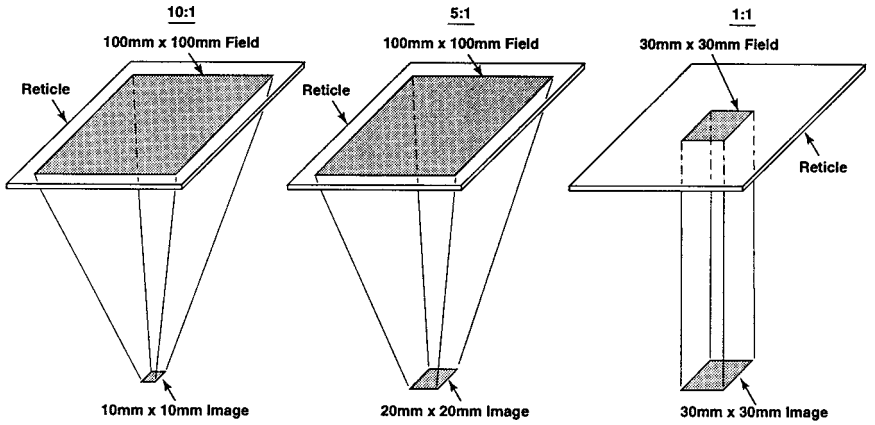
Photolithographic Alignment Technology

Equipment	Critical Relationship
Contact	Bring the mask and wafer into direct contact → damage the mask or contaminate the wafer
Proximity	Gap-setting mechanism and other components
Scanning	Interactions between lens and other components
First-generation stepper	Interactions between stage and alignment system
Second-generation stepper	Relationship between lens and mechanical system

Simplified Representation of Exposure Systems



Comparison of Stepper Reticle Sizes



Die Per Field of Exposure Die Size			
1mm x 1mm (40 x 40 mils)	100	400	900
5mm x 5mm 200 x 200 mils)	4	16	36
10mm x 10mm (400 x 400 mils)	1	4	9

Photolithographic Alignment Equipment Industry

Alignment equipment

Firm	Contact	Proximity	Scanners	Step 1	Step 2
Cobilt	44		< 1		
Kasper	17	8		7	
Canon		67	21	9	
Perkin-Elmer			78	10	< 1
GCA				55	12
Nikon					70
Total	61	75	99+	81	82+

Failure Response

- Company accurately forecasts the progress of individual components in different system but fails to see how new interactions in component development.
  - Processing error from user
  - Merely a copy

Discussion and Conclusions

- Need to deepen our understanding of the traditional distinction, since the essence of architectural innovation is that it both enhances and destroys competence.
- Architectural innovation view provides useful perspective in understanding technically based rivalry in a variety of industries.
- Organizational learning plays an important role on the effect of an architectural innovation.
- For an established firm, how to manage the architectural innovation is a quite difficult issue. A dilemma.