

Innovation and Creativity in Organizations and Work

Process & Dynamics of Innovation

DYNAM 692

November 2010

Creativity and Innovation in Organizations: Course Sessions

Core topics

- **Techniques for innovating**
- **Creativity**
- **Innovation from within Organizations:
Case INEX, Issue-selling**
- **Process & Dynamics of Innovation**
- **Management of Innovation**

Process & Dynamics of Innovation

- Seminal Studies
- Market Effects
- Dominant Design

Seminal Studies

Morison, *Gunfire at sea: A case study of innovation* (1966)

Rogers, *The diffusion of innovations* (1974-2010)

Hounshell, *From the American system to mass production, 1800-1932* (1984)

Mowery & Rosenberg, *Paths of innovation: Technological change in 20th century America* (1998)

Tedlow, *Giants of enterprise: seven business innovators and the empires they built* (2001)

Morison, *Gunfire at sea: A case study of innovation* (1966)

- Continuous-Aim Firing (keep sight and gun barrel on target throughout ship roll)
- Basic Invention vs. Combined Elements (gun, elevating gear, and telescope were combined)
- Bureaucratic obstacles:
 - Disbelief
 - Protection of existing processes & skills,
 - Maintenance of the societal status quo
- Scott -> Sims -> Teddy Roosevelt (personality / status / determination + innovation = adoption)

Rogers *The diffusion of innovations* (1974-2010)

■ Diffusion

Process by which an innovation is communicated through certain channels over time among the members of a social system

■ Process

Innovation – idea, practice, or object perceived as new

Communication – create & share info towards understanding

Time – first awareness, current stage, and rate of adoption

Social system – interrelated units engaged in solving

Hounshell, *From the American system to mass production, 1800-1932 (1984)*

- Mass Production (assembly line manufacturing techniques)
 - Henry Ford's Model T
 - Eli Whitney's Cotton Gin
- Productivity Dilemma (increase product changes = decrease productivity)

Krafcik (1988) Triumph of the Lean Production System

- Lean production: low inventories, production flexibility, minimal rework, statistical quality control, and a skilled, dedicated work force
- 3rd major paradigm of industrial organization, succeeding mass production (which itself replaced “craft production”)
- How Japanese automakers supplanted those of North America. Womack, Jones & Roos: *The machine that changed the world* (1990)

Tedlow --Giants of enterprise: seven business innovators and the empires they built (2001)

- Founding and Building New Businesses (Americans do best)
- Innovators (Carnegie, Eastman, Ford, Watson, Revson, Walton, Noyce)
- Innovators vs. Innovating Companies (business leaders who become inseparable from their firms)

What about all of the businesses leaders that fail?

Technology, Market Change and Innovations

Innovation through architecture is distinct

Innovation can be radical and discontinuous

Innovation follows cycles of technological change

Innovation maps onto a technology S-curve

Henderson & Clark, *Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms* (1990)

- Architectural Innovation

 - not incremental or radical, but rather changes in the architecture of a product without changing the components

- Example

 - semiconductor photolithographic alignment equipment industry

- Implication

 - architectural changes are difficult for firms to recognize/correct

Utterback (1994) *Mastering the Dynamics of Innovation*

Chapter 7: *Invasion of a stable business by radical innovation*

- Radical Technological Innovation
 - Technology that invades – and eventually overwhelms – the established technology
- Example
 - America's ice industry: machine-made replaced harvested
- S-Curve
 - Development slow at first, and then accelerates with a dominant design, and then slows again as efforts shift to new technology

Anderson & Tushman (1991)

Managing through cycles of technological change

- Cycles of Technological Change
 - Technology progresses in cycles that hinge on discontinuities and emergence of dominant designs
- Creative Destruction
 - Fundamental to capitalist progress – Schumpeter
- Competency-Destroying
 - Obsolete existing know-how, nullify mastery of old

Foster (1986) *Innovation: The attacker's advantage.*

Chapter 4: The S-curve: A new forecasting tool

■ S-Curves

- Learning followed by diminishing returns; repeated

■ Examples

- Artificial hearts, pocket watches

■ Forecasting Tool

- Competitive analysis of effort put in and results achieved

Christensen (1992) *Exploring the limits of the technology S-curve. Part I: Component technologies*

- • S-Curve Scope
 - More applicable at the industry level than firm level
- Reverse Causality
 - lack of technological progress may be the result, rather than cause, of a forecast that a technology is maturing
- Component Innovation
 - attacking firms have a disadvantage with new components

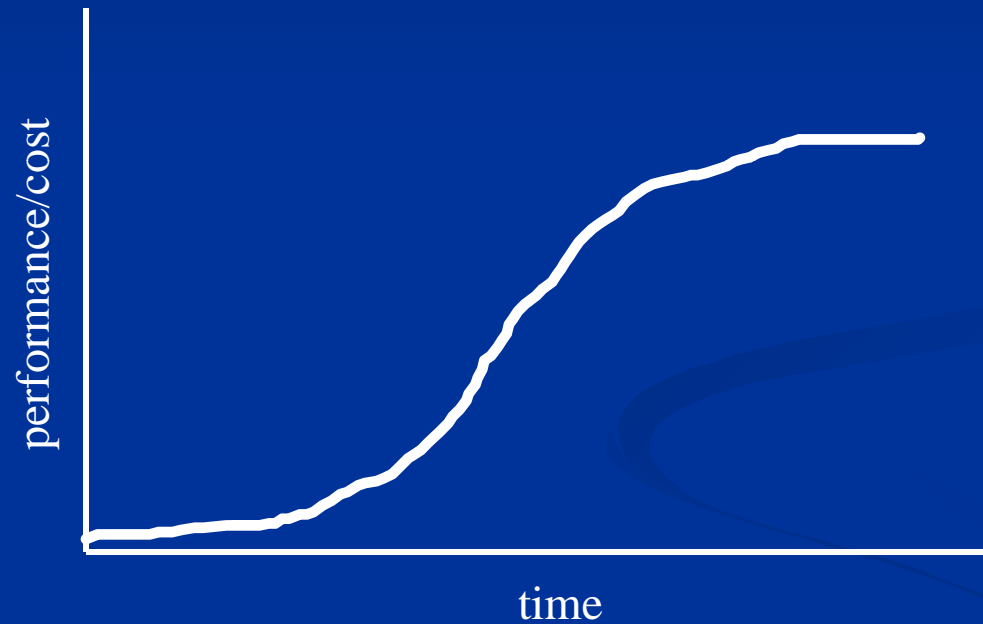
Christensen: Innovator's Dilemma (1997), Innovator's Solution (2004)

- Keeping close to customers – sometimes to the fatal end
- Sustaining vs. Disruptive Technologies (increased rate vs. redefined performance trajectory)
- Established vs. Entrant Firms (founded before vs. after advent of the technology)

Dominant Design

- A product or service with a clear identity, a standard that we take for granted and has become widely diffused
 - Car
 - Windows
 - Pizza
 - Currency Swap
 - Endoscopy

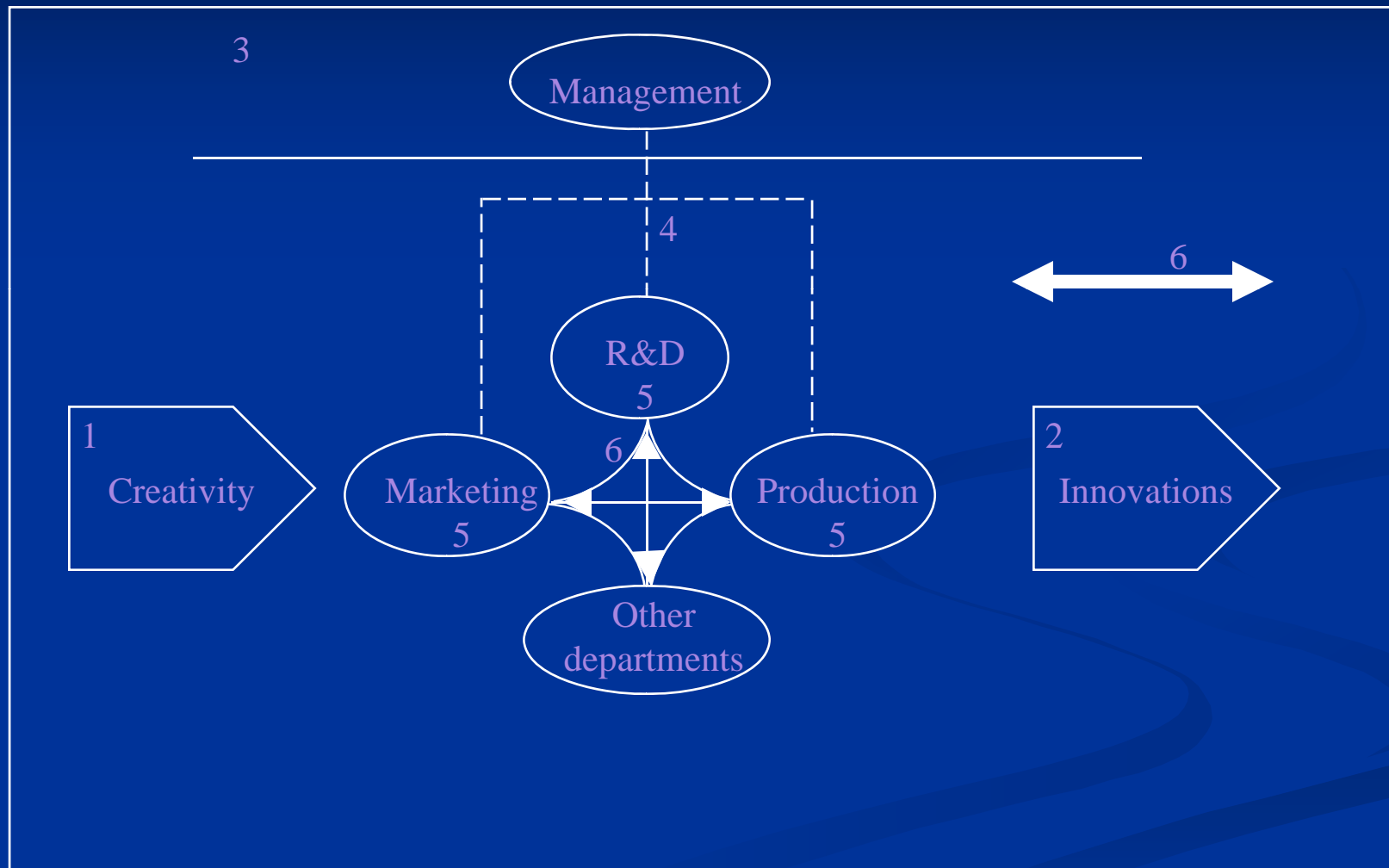
Patterns of Technological/Market Evolution

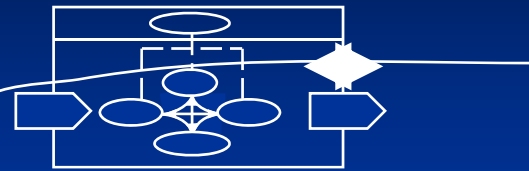


Strategic Focus Evolves with the S-curve

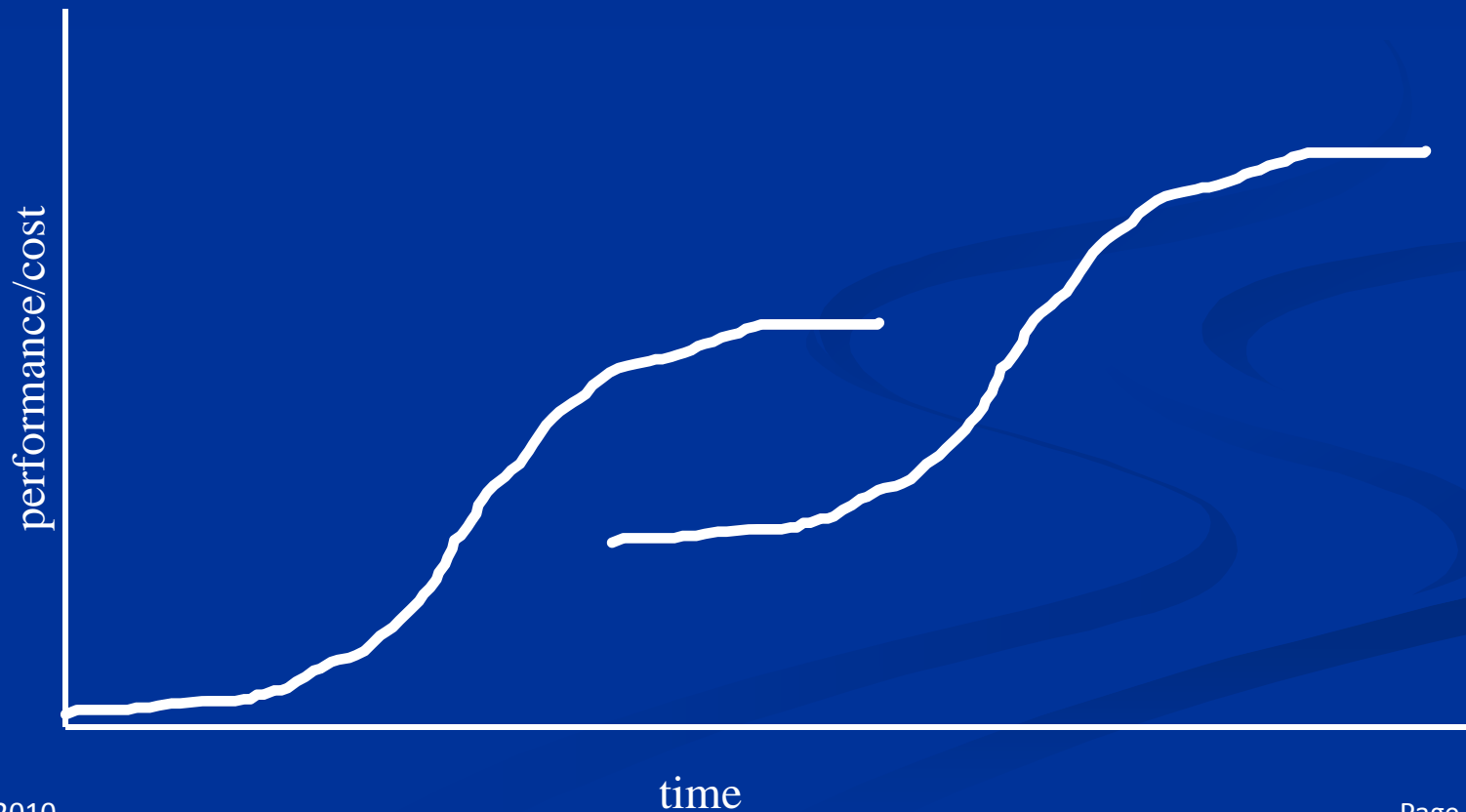
- Compare “product life cycle”
- Emergence of dominant design
- From product to process innovation
- From functionality to volume and standardization
- From flexibility to control

Creativity, organization, and innovation



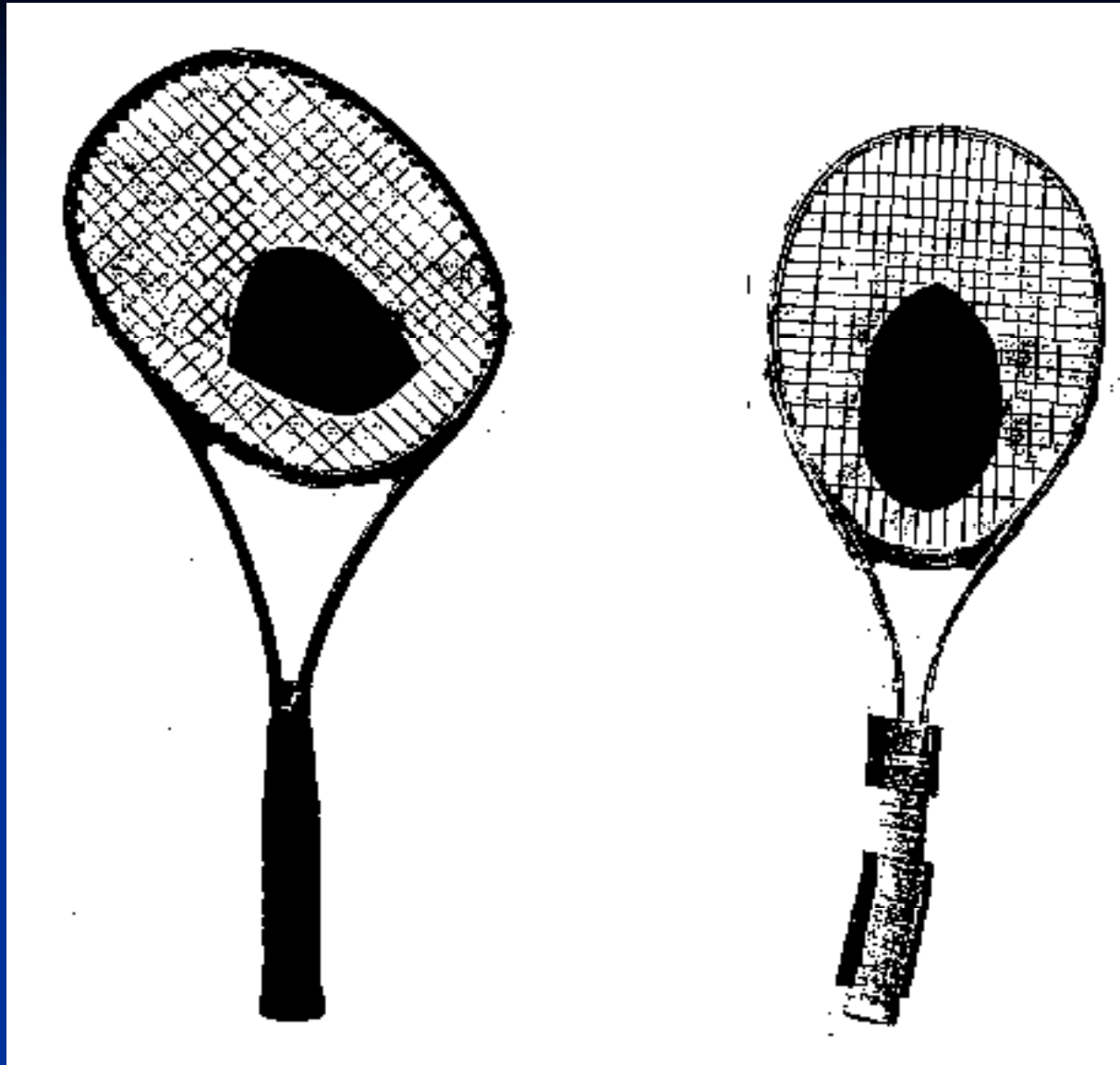


Technological Substitution



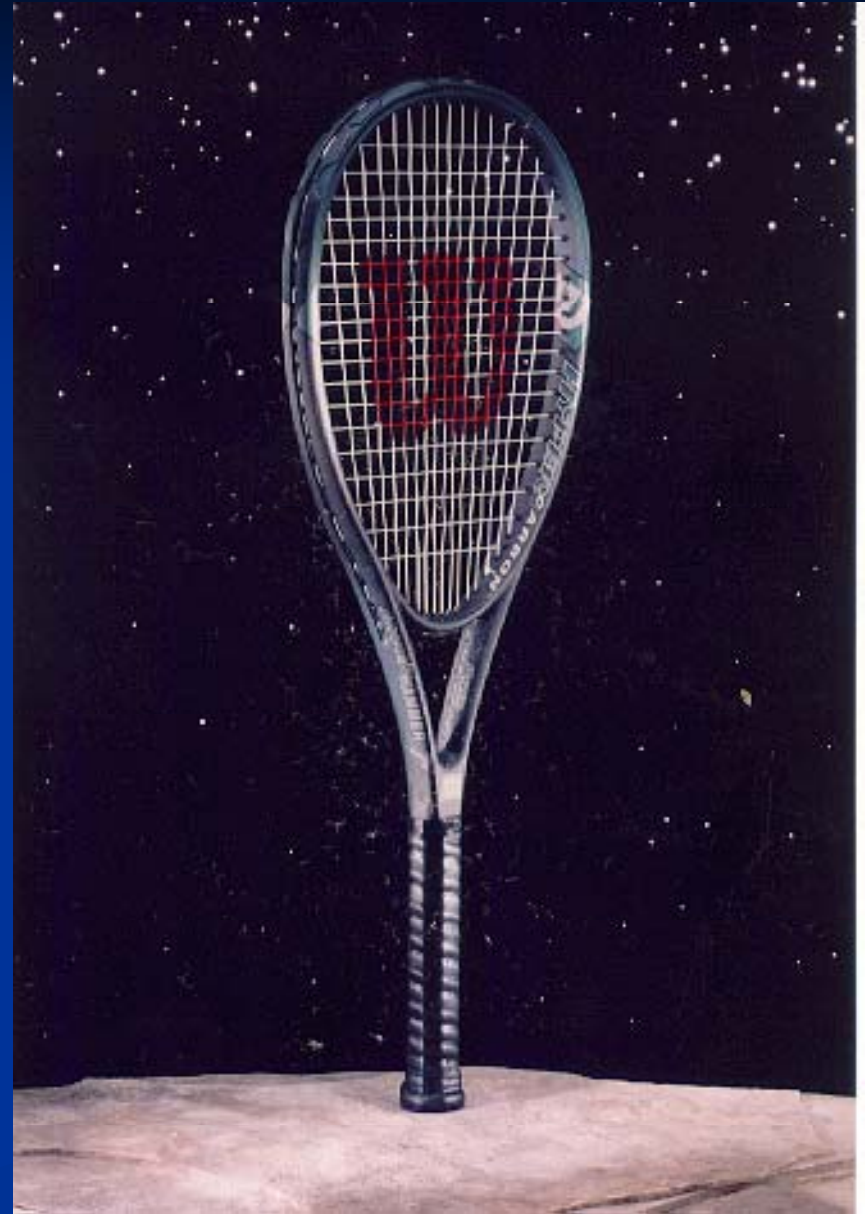
Innovation: a matter of *life and death*

- Think of a product that got pushed out of existence?
- Why did substitution occur?
- What happened to the “Owners” of that dominant design?



Two racket designs that did not become a dominant design

A modern racket design that might embellish the dominant design



Dominant Design Industry Effects

Products and process culminate in a dominant design

Dominant designs become replaced by new ones

Dominant designs entail product/service attributes, but also legal, institutional, cultural, marketing conditions

Firms co-evolve with dominant design and might face inertia problems

Death of dominant design comes often with flood of “chapter 11s”

Dominant Design

- Components *and* architecture
- Role of politics, regulation, markets, fashion, collusion
- Tension between Environment (technology, market and other aspects of the landscape) and Firm

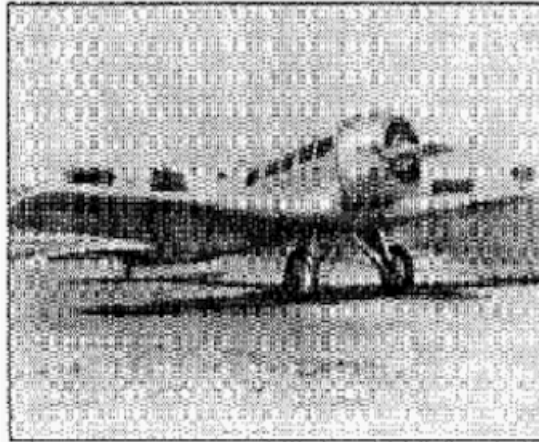
Dominant Design and Strategic Challenges

- **Components and architecture**
 - e.g., speakers, turntable, etc. (stereo “system”)
- **Role of science, politics, regulation, markets**
- **Additional examples**

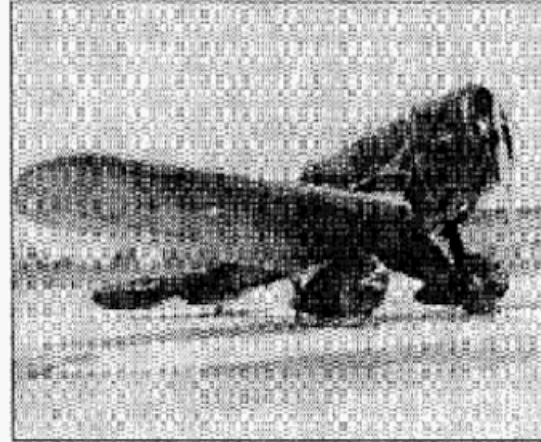
Dominant *Airplane* Design

- Propulsion: propellers to jets
- Landing Function: 4 steps

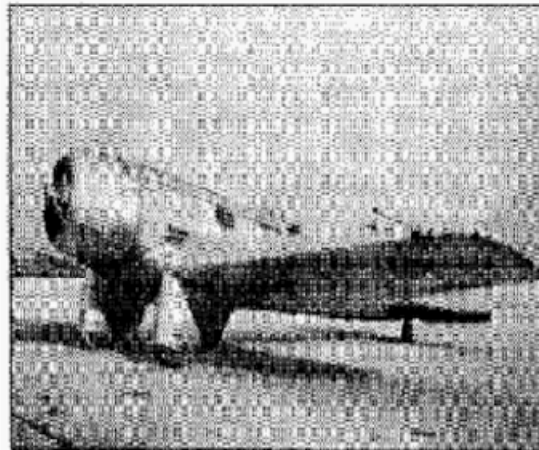
Figure I: Variations in Landing Gear



Fixed Landing Gear



Wheel Pants Landing Gear



Trouser Landing Gear

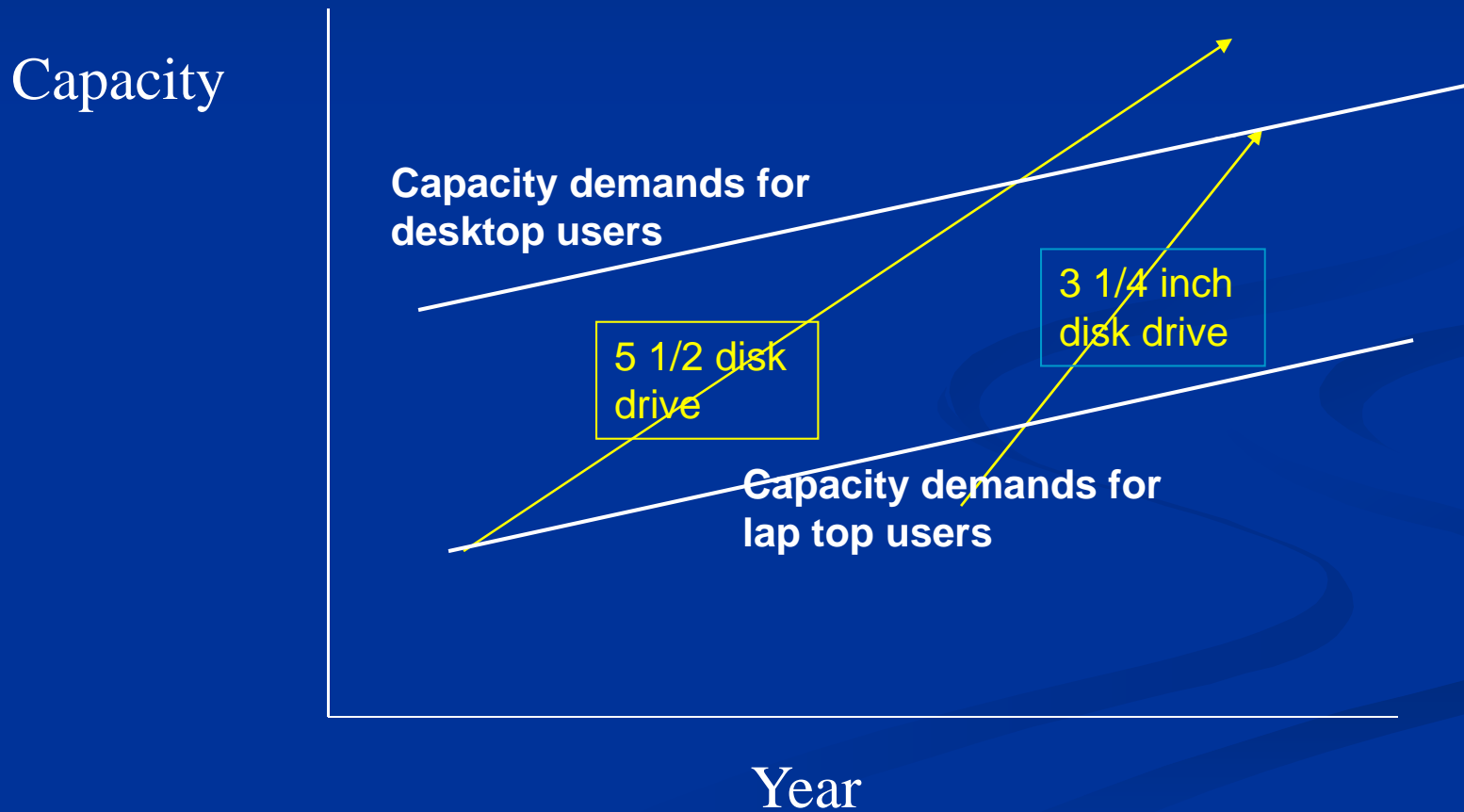


Retractable Landing Gear

Dominant *Airplane* Design

- Landing Gear
- System Architecture.
 - In 1936 DC3 became dominant design [the “standard”]
 - In 1959, Boeing 707 replaced it.
- Not simply technology, but also regulation, politics, value chains, networks, and other socio-economic factors effect dominant design

Same technology, new dominant design, meeting different needs is *disruptive technology*



GM: A firm struggling with problem architecture

- Why does GM want to stick to one-key car?
- Could the firm share 'key template' across ignition and body SUBs
- Why can't GM change? Have inertia problems?

GM Two car-key problem

■ Internal:

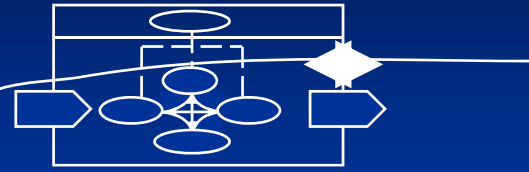
- Lack of overlap between units
- *Design* of firm matches product's *architecture*
- *Organizational Culture* and attitudes

■ External:

- Needs of customers
- Role of competition

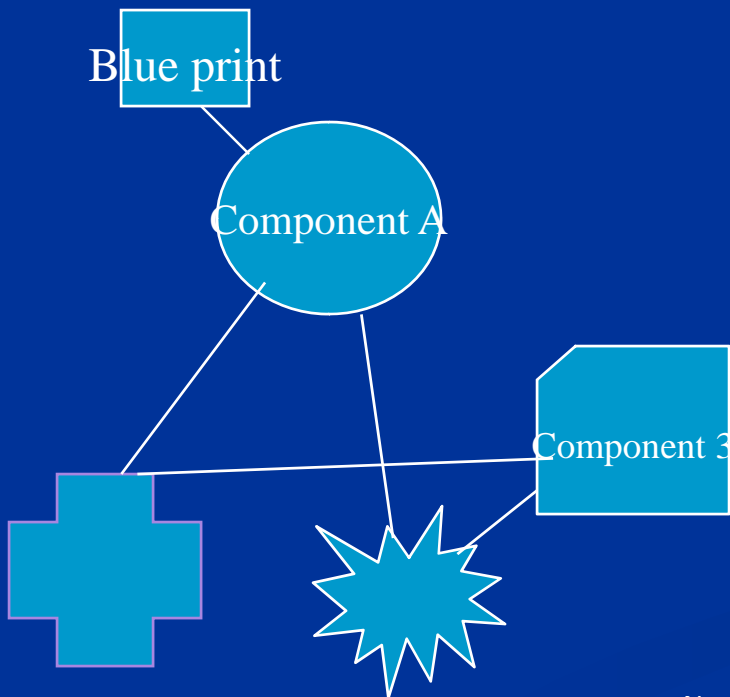
Change in Dominant Design

- **Something new, but how new is new?**
 - **Radical Innovations**
 - **Incremental Innovations, but also:**
 - **Architectural Innovations; supposedly incremental, but radically different in architecture:**
 - from propellers to jet engines
 - from ceiling fan to table fan
 - from big car to small car
 - from personal computer to networked computer?
 - From offset printing to digital printing
 - from personal tellers to automated tellers
 - **Dominant Design issues?**

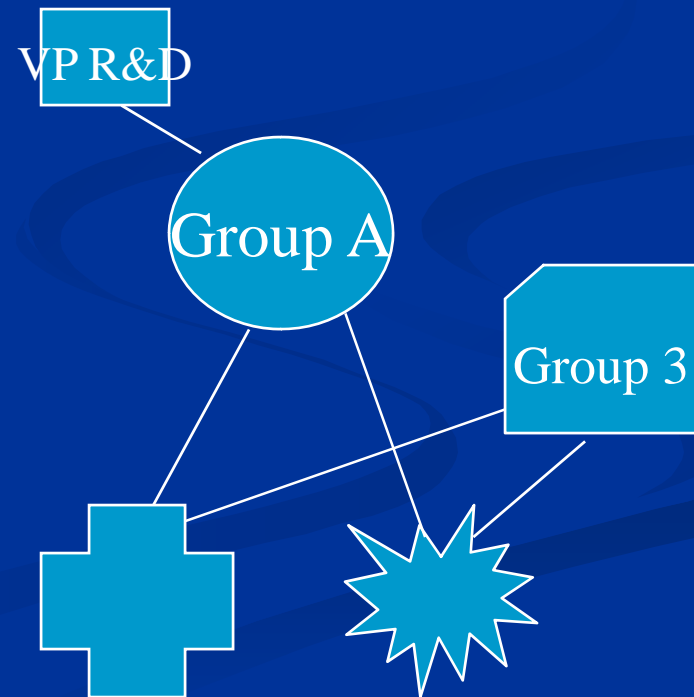


Dominant Design *matches* Firm and Value Chain Design

Product Architecture



Organization Structure & Interaction Patterns



Creativity: New Firm

- New firms start with a clean slate
- New firms have structures that fit the emerging dominant design, new paradigm
- New firms sneak into the playing field whose players are blinded by their paradigm
- Only firms endowed with *dynamic capabilities* might survive the onslaught of new entrants!

Dominant design Summary

- Dominant design (technology&market) involves *components* and *architecture*
- Existing firms are often saddled with a product design that fits their organization, and become afflicted with *North-east* bias.
- New firms are flexible and can create new design template and new organization