

The Economics of E-commerce and Technology

Innovation

Impact of Innovation

- ▶ **Enhance competitive advantage of incumbent.**
 - ▶ PlayStation3 (Sony)
 - ▶ Laserjet printer (Hewlett Packard)
- ▶ **Destroy the incumbent (creative destruction).**
 - ▶ MP3 player (Sony vs. Apple)
 - ▶ Computers (Microsoft and Intel vs. IBM)
 - ▶ Digital cameras (Kodak vs. Sony)
- ▶ **Create new markets.**
 - ▶ Children's TV (Disney vs. Nickelodian)
 - ▶ Light motorbikes (Triumph vs. Honda)

Types of Innovations

- ▶ **Value enhancement**

- ▶ Pneumatic tyres (1845)
- ▶ Cotton replaced by rayon (1938)
- ▶ Run flat tyres (1974)

- ▶ **Cost reductions**

- ▶ Banbury mixing (1916)
- ▶ Rayon replaced by nylon (1958)

- ▶ **Gradual vs. Drastic**

- ▶ Drastic can put competitor completely out of business.
- ▶ Not the same as “disruptive technology”.

The Lifecycle of Innovation

▶ **Questions**

- ▶ How does industry structure changes product life?
- ▶ When does entry occur?
- ▶ When are profits made?

▶ **Difficulties:**

- ▶ Products are all different.
- ▶ Analyze successful products, but most not successful.
- ▶ What's a new product?

▶ **Four phases: Introduction, Growth, Maturity and Decline.**

Phase 1: Introduction

- ▶ **Begins with few firms**
 - ▶ If successful, rapid entry.
 - ▶ Firms make loss.
 - ▶ 99% of ideas die.
- ▶ **Market is small**
 - ▶ First adopting customers are not typical.
- ▶ **Heavy promotion**
 - ▶ Market education. Free samples.
 - ▶ Low pricing.
- ▶ **Insure customers against product risk**
 - ▶ Money back guarantees.
 - ▶ Help implementation and servicing.

Phase 2: Growth

▶ Market

- ▶ Growth keeps competition down
- ▶ Falling costs
- ▶ High cost and poor quality firms will die
- ▶ Others make large profits

▶ Product

- ▶ Products improve over time
- ▶ Standardization: handful of major designs

▶ Strategy

- ▶ Distribution becomes important
- ▶ Cultivate brand name
- ▶ Prepare for shakeout

Phase 3: Maturity

▶ Market

- ▶ Demand stabilizes. Seek growth abroad.
- ▶ Shakeout

▶ Cost Strategy

- ▶ Minimize costs. Efficient Distribution
- ▶ Basic model becomes a commodity (e.g.VCRs)

▶ Value Strategy

- ▶ Focus on niche
- ▶ Differentiate product

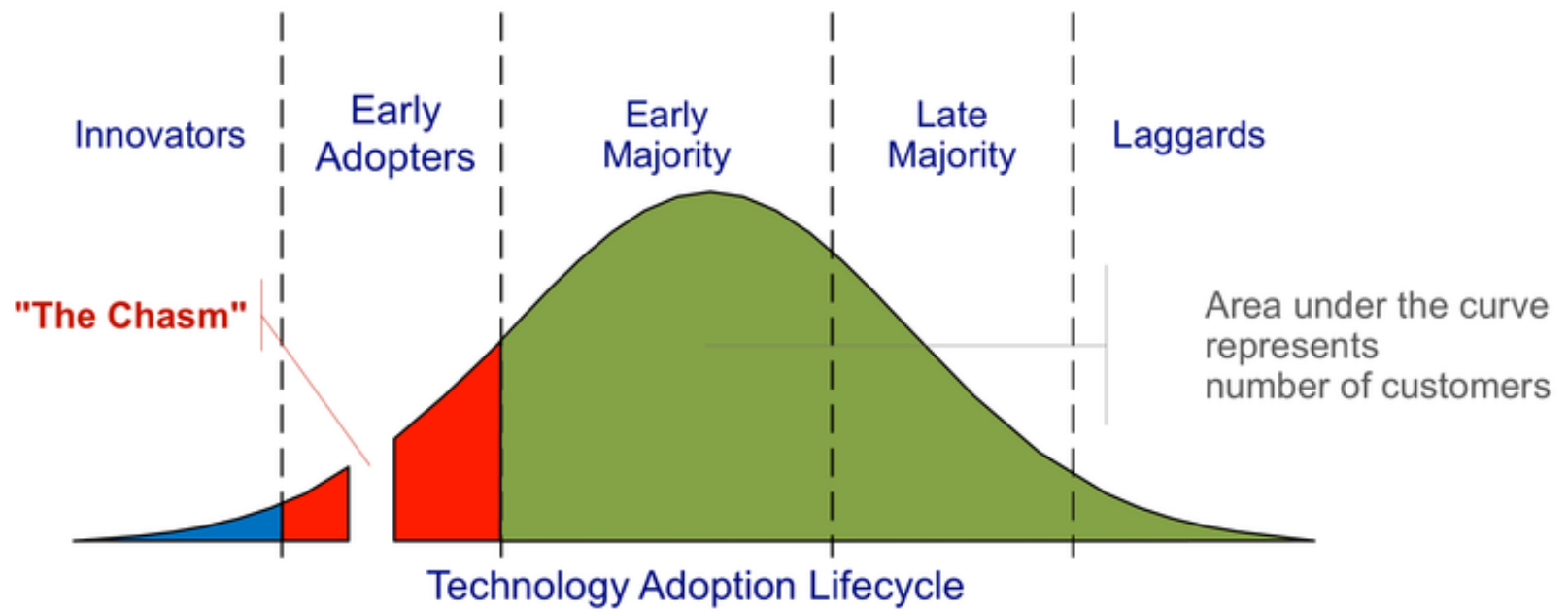
Phase 4: Decline and Replacement

- ▶ Reasons for declines
 - ▶ Technological progress (e.g. B&W TVs)
 - ▶ Changing tastes and new info (e.g. fashion or CFCs)
- ▶ Strategy 1: Focus on profitable segments
 - ▶ Market changes (e.g. B&W TVs as security monitors).
- ▶ Strategy 2: Harvesting.
 - ▶ Don't replace capital. Exit when $p \leq MC$.
- ▶ Strategy 3: Industry consolidation
 - ▶ Importance of coordination
 - ▶ Excess capacity leads to ruinous price wars.
 - ▶ Strategies 1–3 compliment each other.
- ▶ Complain to government.

Product Diffusion

Roger's Diffusion Model

- ▶ Diffusion is process through which new idea or product spreads.
- ▶ Questions:
 - ▶ How fast will product be adopted?
 - ▶ What factors affect technology adoption?
 - ▶ What strategies can we adopt
- ▶ We can broadly divide people into
 - ▶ Innovators – who experiment with product
 - ▶ Imitators – who learn from experience of others

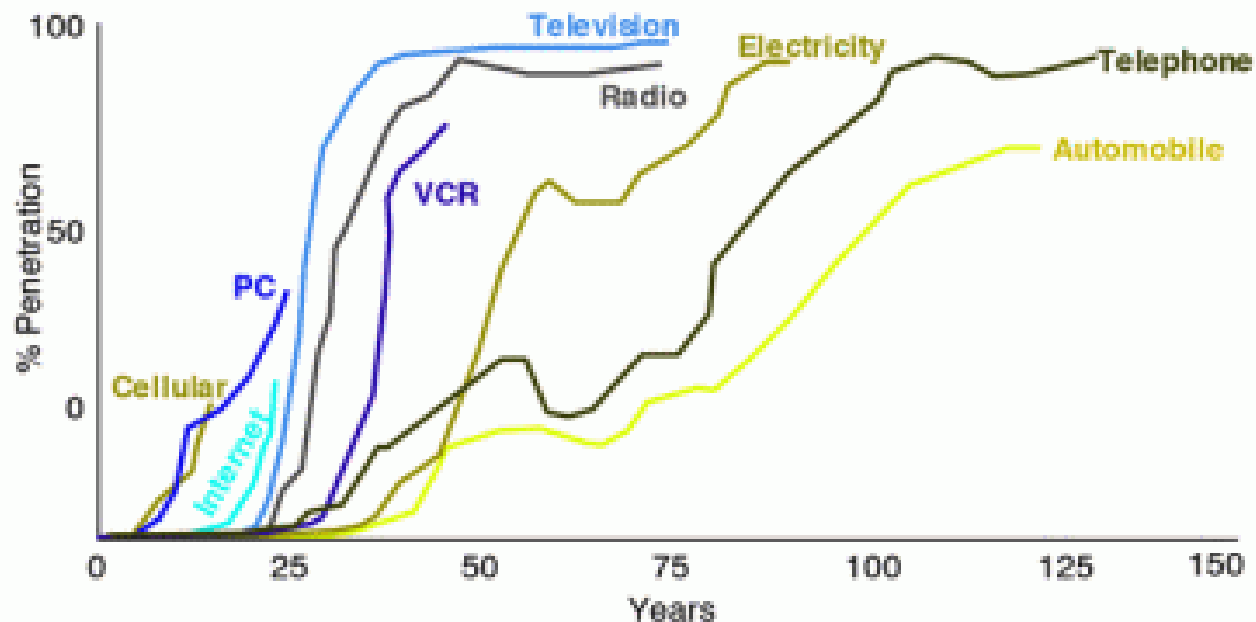


Examples of Diffusion Curves

Facilitating Innovation

the pace of innovation is increasing

- Newer technologies taking hold at double or triple previous rates



Innovators (Techies)

- ▶ Technology enthusiasts
- ▶ Willing to learn
- ▶ Appreciate technology for its own sake
- ▶ Motivated by idea of being change agent
- ▶ Willing to tolerate initial problems
- ▶ Venturesome, educated
- ▶ How to sell to these
 - ▶ Product should be technologically interesting
 - ▶ Product should be novel in some dimension
 - ▶ Advertise in specialist outlets

Early Adopters (Visionaries)

- ▶ Want new technology to improve function.
- ▶ Want discontinuous breakthrough improvement
- ▶ Social leaders
- ▶ Attracted by high-risk, high-reward
- ▶ Anxious, champions
- ▶ Selling to these
 - ▶ Sell “dreams” that are clearly defined
 - ▶ Relate directly to objective
 - ▶ Demand personalized solutions
 - ▶ Reference other visionaries
 - ▶ Price is secondary; they want it right, complete, quickly, on time

The Early Majority

- ▶ Want incremental improvement
- ▶ Evolutionary, not revolutionary products
- ▶ Want proven, established products
- ▶ Don't sell dreams; sell reality
- ▶ Deliberate; less risk seeking
- ▶ Selling to these
 - ▶ Proven product
 - ▶ They want to know many satisfied customers
 - ▶ Buy whole products
 - ▶ Want lower prices

Finally...

- ▶ **Late majority (conservatives)**
 - ▶ Skeptical, traditional
 - ▶ Price sensitive
 - ▶ Want product mature, preassembled, with clear solutions
 - ▶ Don't like change
- ▶ **Laggards (skeptics)**
 - ▶ Only buy technology if necessary
 - ▶ Only now thinking about buying a cell phone
 - ▶ A hard sell

Moore's Chasm

▶ Visionaries

- ▶ Willing to take risks to obtain radical improvements
- ▶ Change agents

▶ Pragmatists

- ▶ Want incremental improvements
- ▶ Want comparisons, and solid references
- ▶ Price sensitive; more steps in sales strategy

▶ The chasm

- ▶ Tech firms must first sell to visionaries; then need to change
- ▶ Requires significant changes in marketing/sales strategy
- ▶ Many firms never overcome this leap

What Determines Speed of Diffusion?

- ▶ **Relative Advantage**
 - ▶ Improvement over old products
- ▶ **Switching costs**
 - ▶ Compatibility with previous systems and skills.
 - ▶ Complexity of learning new product
- ▶ **Network effects**
 - ▶ Degree to which my value depends on no. of users.
- ▶ **Trialability**
 - ▶ Ease of experimentation (cell phone vs. fridge)
- ▶ **Observability**
 - ▶ Visibility to others (iPhone vs. home computer)

Bass Model of Diffusion

- ▶ Let $f(t)$ be the probability an agent first adopts at time t .
- ▶ Suppose hazard obeys

$$f(t)/[1 - F(t)] = p + qF(t)$$

so the no. of new adopters is linear in the no of users.

- ▶ Solving this differential equation,

$$f(t) = \frac{(p + q)^2 e^{-(p+q)t}}{\left(qe^{-(p+q)t} + p\right)^2}$$

- ▶ Bass (1969) estimated parameters p (no. of innovators) and q (importance of imitation) for different products.

Adoption Incentives

- ▶ Firms have different ideal times in adoption
 - ▶ Expect to be S-shaped, as with consumers.
- ▶ Firms may be substitutes
 - ▶ When MRI scanners first adopted, only one hospital needed one
- ▶ Preemption in adoption
 - ▶ Adopt early in order to steal market
 - ▶ e.g. if firms Bertrand competitors, race to be first to adopt
- ▶ Delayed adoption.
 - ▶ Suppose duopolists make positive profits.
 - ▶ If A adopts, B may adopt to regain market share.
 - ▶ Anticipating firm B's reaction, A refuses to adopt.

Innovation Incentives

Incentive to Innovate: Replacement Effect

- ▶ Who innovates more: Incumbant or Entrant?
 - ▶ Innovation reduces costs to c_L
 - ▶ Let i 's profit with costs (c_i, c_j) be $\Pi(c_i, c_j)$
 - ▶ Suppose opponent innovates (worst case scenario)
 - ▶ Suppose entrant enters if and only if she innovates.
- ▶ WTP of incumbent, $V_I = \Pi(c_L, c_L) - \Pi(c_H, c_L)$.
- ▶ WTP of entrant, $V_E = \Pi(c_L, c_L) - \Pi(\infty, c_L) > V_I$.
- ▶ Entrant has higher willingness to pay.
 - ▶ Incumbent cannibalizes herself (e.g. Nintendo vs. Sega).

Incentive to Innovate: Efficiency Effect

- ▶ Who innovates more: Incumbent or Entrant?
 - ▶ Suppose 3rd party sells patent.
 - ▶ Suppose entrant enters if and only if she innovates.
- ▶ WTP of incumbent, $V_I = \Pi(c_L, \infty) - \Pi(c_H, c_L)$.
- ▶ WTP of entrant, $V_E = \Pi(c_L, c_H) - \Pi(\infty, c_L)$
- ▶ Incumbent usually has higher willingness to pay
- ▶ – Monopolist makes more profits than two duopolists
- ▶ Key: If I innovates, then E does not. For example,
 - ▶ I and E compete in patent race.
 - ▶ E only enters if strictly more efficient.

Patenting Strategy

▶ Patents vs. Trade Secrets

- ▶ Obtain 17 yrs protection, but disclose details of innovation.

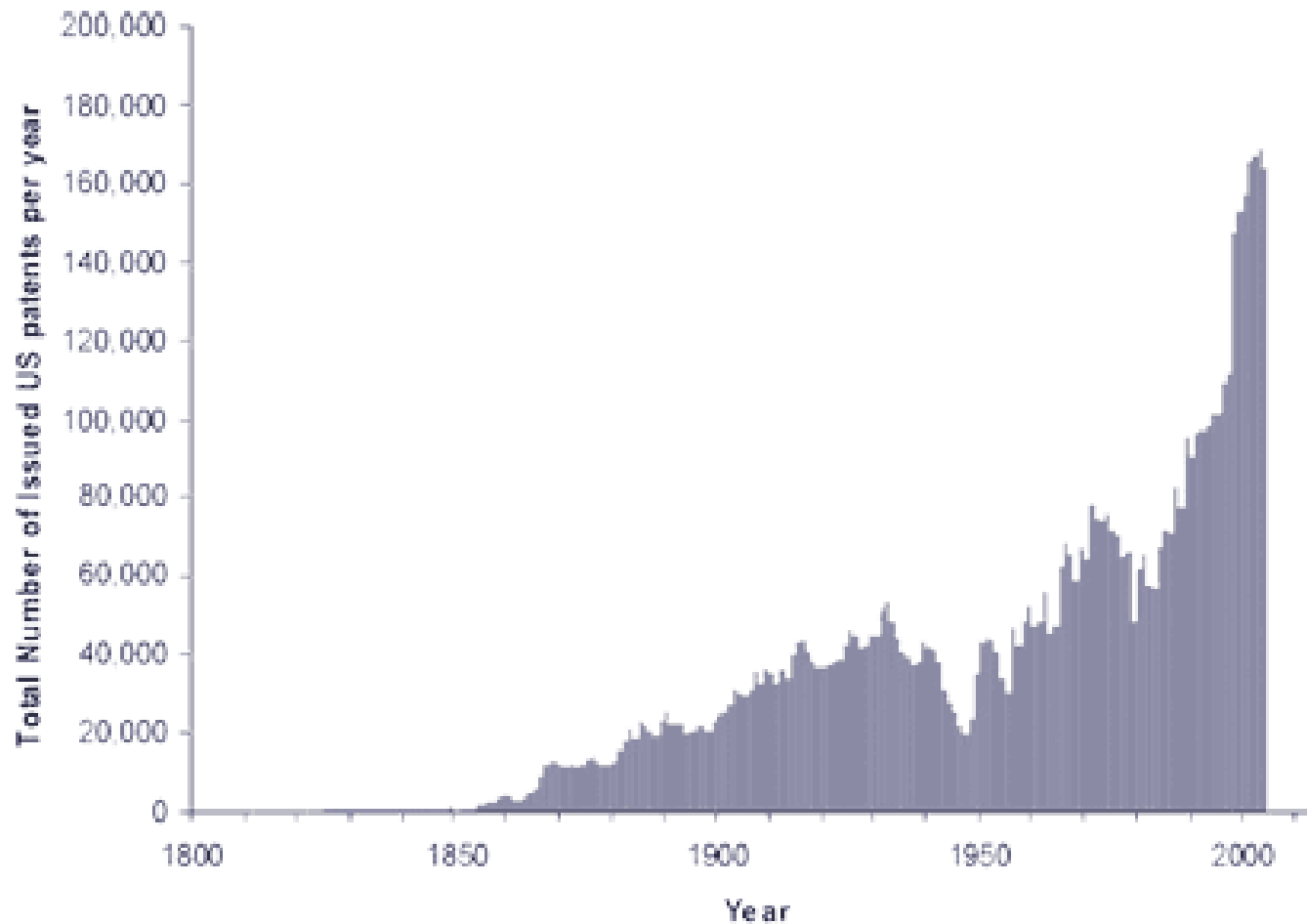
▶ Which is better?

- ▶ Can the competition use information in patent disclosure?
- ▶ Can they get around the patent?
- ▶ Can they see through trade secrets?
- ▶ Do you wish to license or sell the idea?
- ▶ Do you wish others to improve on the idea?
- ▶ How quickly will returns come?

▶ Computer industry

- ▶ IBM invests \$5bn in R&D, while MS invests \$6bn.
- ▶ IBM obtained 3250 patents in 2004; licenses many.
- ▶ MS obtained 650. Relies on trade secrets

Growth in patents



More Patenting Strategy

▶ Protective patents

- ▶ Patent all substitutes, including inferior technology.
- ▶ Analogy: spatial preemption.

▶ Defensive patents

- ▶ Patent holes in competitors process.

▶ Timing of Patents

- ▶ Suppose two ideas are complements.
- ▶ Then can wait to patent idea 2, extending effective patent.
- ▶ Danger: someone patents before you do.

Technology Transfer

- ▶ Innovator may not have comparative advantage in using idea.
- ▶ Licensing
 - ▶ Buyer receives right to exploit innovation.
 - ▶ Receives technical assistance and pays fixed fee or royalty.
 - ▶ Example: In 2004, IBM earned \$1.2bn by licensing.
- ▶ Acquisition of patent
 - ▶ Seller forgoes independent commercialization.
 - ▶ Allows firms to specialize in innovation.
 - ▶ Buyer can assemble complimentary patents.
- ▶ Acquisition of innovator
 - ▶ Buyer purchases idea and innovator's capabilities.

Motivating Innovation

- ▶ How should a firm provide incentives to innovate?
 - ▶ WHO provides incentive to develop AIDS drug.
 - ▶ DARPA provides incentives to develop cheap spaceship.
 - ▶ Large firms need to provide incentives internally
- ▶ Push strategies - fund R&D directly.
- ▶ Pull strategies - award winners.
 - ▶ Give one prize or many?
 - ▶ Give prizes for incremental steps?
 - ▶ How define success?
 - ▶ Example: Lockheed–Martin makes divisions compete.

Disruptive Innovation

The problem of repeating success

- ▶ Main frames – IBM
- ▶ Minicomputers – Digital Equip, Data General
- ▶ Desktop computers – Apple, Commodore, Tandy, IBM
- ▶ Engineering workstations - Apollo, Sun Microsystems
- ▶ Portable computers – Compaq, Zenith, Toshiba, Sharp
- ▶ Netbooks – Asus, Acer
- ▶ Tablets – Apple, Samsung

Types of innovations

- ▶ **Sustaining innovations**

- ▶ Vertical improvements
- ▶ Doing the same, but better
- ▶ e.g. Thin film disks in Hard Drive industry.

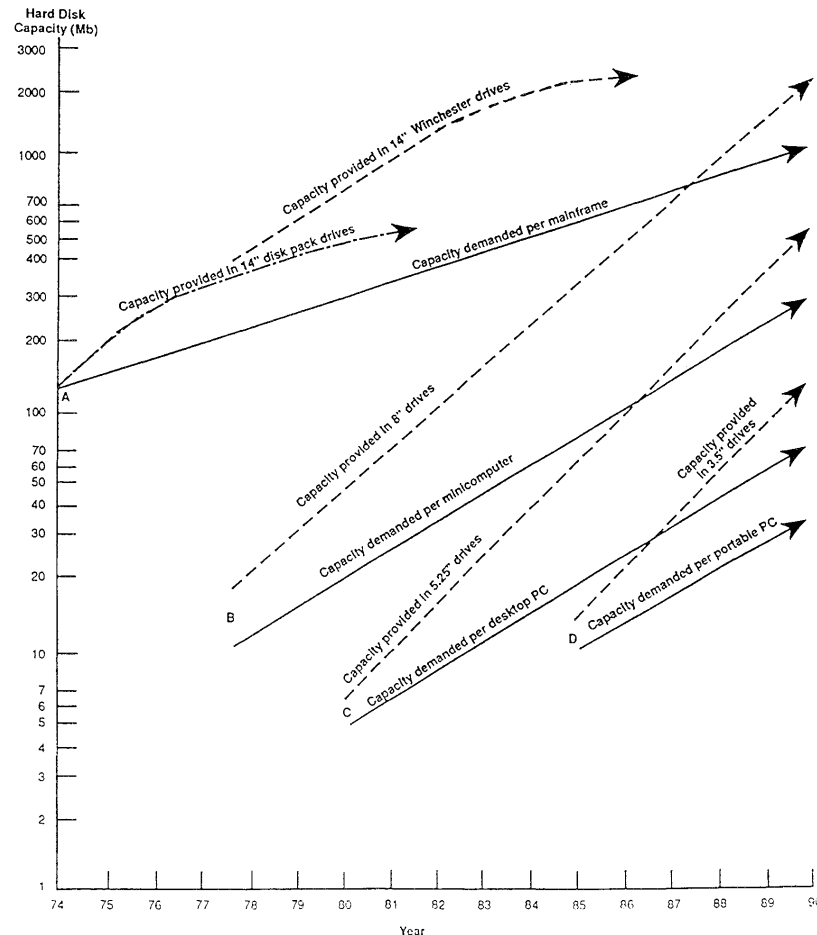
- ▶ **Disruptive innovations**

- ▶ Different package of performance attributes
- ▶ e.g. Architectural innovations - 14", 8", 5.25" and 3.5" drives
- ▶ Low end disruptions – least profitable market segments
- ▶ New market disruptions – emerging market

- ▶ **The disruptive innovation can ultimately takeover**

Disruptive technology takes over (1)

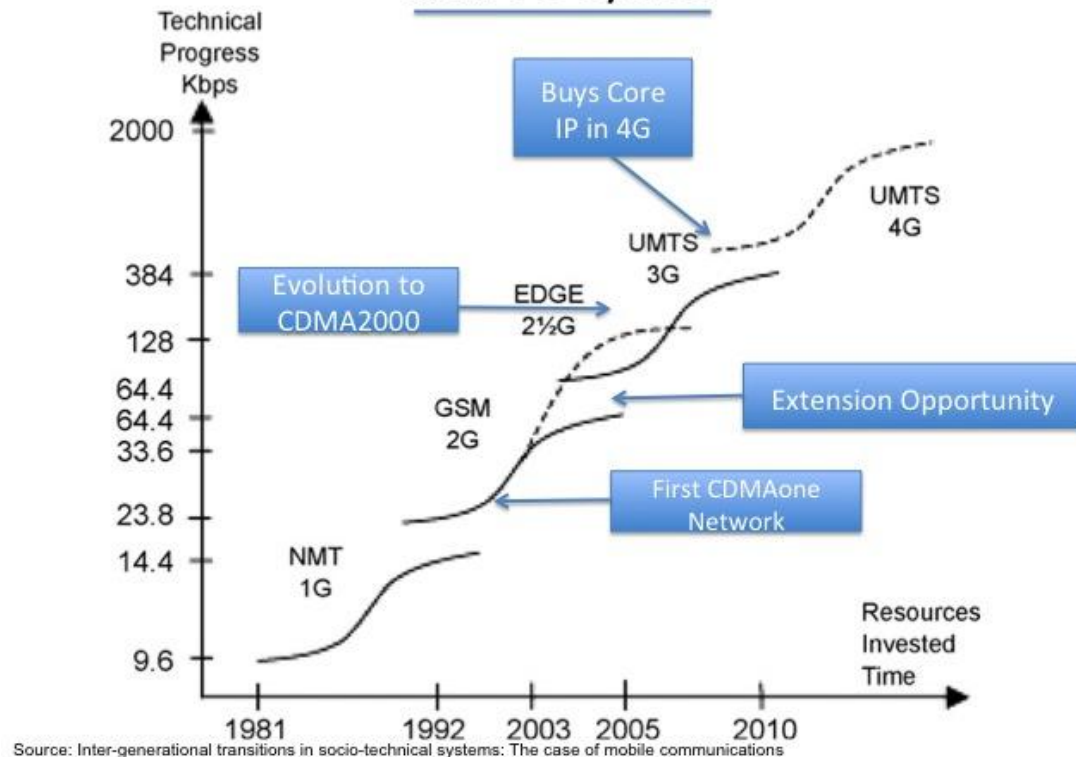
- ▶ Customer demand rises slower than technical progress



Disruptive technology takes over (2)

- S-curves mean decreasing speed of innovation

At the forefront of innovation through 2G, 3G and 4G cycles



Leadership and Innovation

Winchester architecture	Established Entrants Established	1	3	1 3	4 7	9 11	4	11	20	25	26
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(b) Numbers of established and entrant firms introducing models based upon disruptive architectural technologies

		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
8-inch	Entrants					1	4	6	8							
	Established					0	2	5	5							
5.25-inch	Entrants							1	8	8	13					
	Established							1	2	8	11					
3.5-inch	Entrants											1	2	3	4	
	Established											0	1	1	4	

Note: Data are presented in these tables only for those years in which the new technologies were gaining widespread acceptance, to illustrate tendencies in technology leadership and followership. Once the technologies had become broadly accepted, the numbers of firms introducing models using them are no longer reported. Twelve years are covered in the thin-film head category because it took that long for thin film heads to become broadly used in the marketplace. Only 5 years of history are reported for RLL codes because by 1988 the vast majority of established *and* entrant firms had adopted RLL codes. Four years of data are shown for new architectures, because any established firms that had not launched the new architecture within 4 years of its initial appearance in the market had been driven from the industry.

- ▶ Sustaining innovations
 - ▶ Leaders continued to dominate across generations
- ▶ Disruptive innovation,
 - ▶ 1/2 to 3/4 of manufacturers failed to introduce new models
 - ▶ New wave of entrants

Why?

▶ Incumbent's dilemma

- ▶ Managers listen to what *current* customers want.
- ▶ Do what worked in the past.
- ▶ Overcome bureaucratic hurdles to launch new product.
- ▶ Don't want to go down-market.

▶ Example: Seagate

- ▶ Pioneered 5.25" drive, used by IBM for desktops.
- ▶ Developed 3.5" by 1985, but main customers not interested.
- ▶ Former employees founded Conner. Rapid improvement.
- ▶ New customers, e.g. Compaq, making small desktops
- ▶ Seagate entered market in 1987, but then too late.