

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

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.**

A Summary...

BCG Matrix



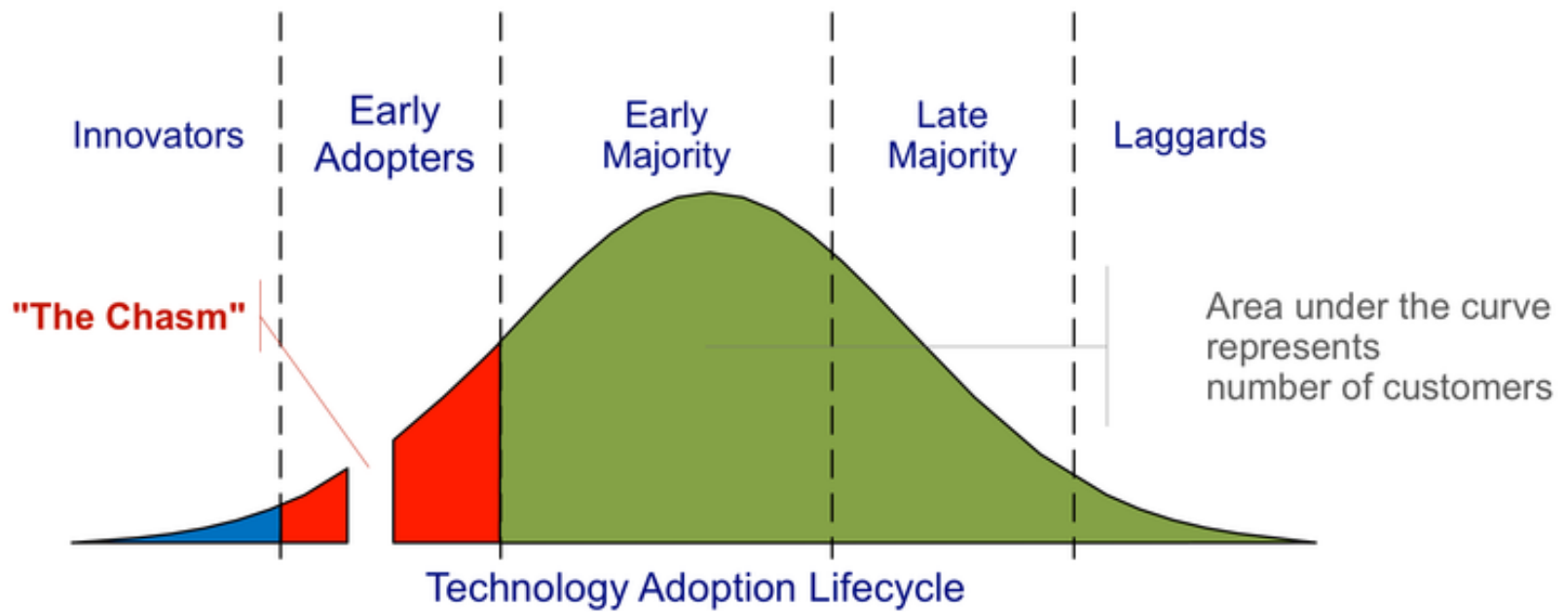
The BCG Matrix approach has been developed by the Boston Consulting Group.



Product Diffusion

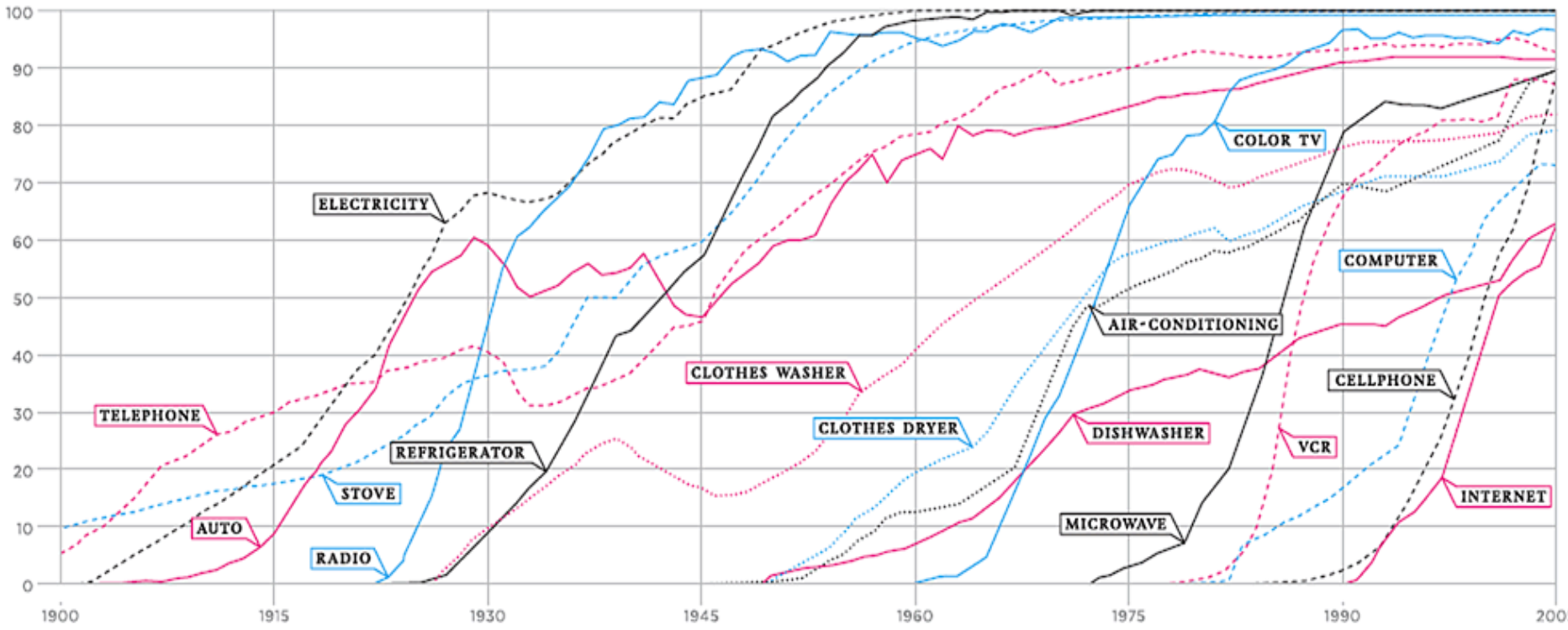
Roger's Diffusion Model

- ▶ 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



PERCENT OF
U.S. HOUSEHOLDS

CONSUMPTION SPREADS FASTER TODAY



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.

Innovation Incentives for Firms

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: Incumbant 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, $V_E = \Pi(c_L, c_H) - \Pi(\infty, c_L) < V_I$
- ▶ 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.

Investment Timing: Pre-emption

- ▶ A single firm considers *when* to acquire a new technology
 - ▶ E.g. A hospital considers buying and MRI
- ▶ Monopoly problem
 - ▶ At time t , innovation costs $c(t)$. Yields flow profits of V .
 - ▶ Firm solves: $Max_T \Pi(T) := \left[\int_T^\infty e^{-rt} V dt - e^{-rT} c(T) \right]$
 - ▶ Yielding FOC, $r\Pi(T) = e^{-rT} [-c'(T)]$
- ▶ Duopoly problem
 - ▶ Suppose only demand for one firm in the market.
 - ▶ Not profitable for second firm to invest (e.g. Bertrand example).
 - ▶ Invest when $\Pi(T) = 0$.
 - ▶ Hence adopt early in order to steal market

Intellectual Property Protection

Trademark

- ▶ A **trademark** is a phrase, symbol, or design that identifies a product, and distinguishes it from others.
 - ▶ Aim to stop customers from mixing up brands.
 - ▶ Strongest trademarks cover words that have no other meanings (Kodak), or are used in unusual way (Apple).
 - ▶ Not to prevent companies from stealing others' ideas.
- ▶ Trademarks established by
 - ▶ Use in the marketplace
 - ▶ Registrations with trademarks office



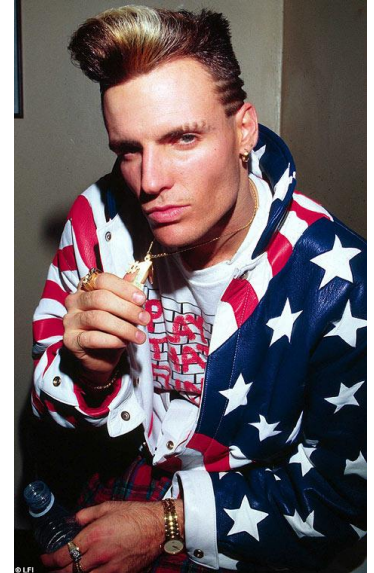
“How” we use words matters



- ▶ Is “How” used in an unusual way?
- ▶ Could customers confuse these?

Copyright ©

- ▶ **Copyright** grants the creator of an original work exclusive rights to its use and distribution.
 - ▶ To incentivize people to create content.
 - ▶ Does not cover ideas and information themselves, only the form or manner in which they are expressed
 - ▶ Duration is life of the creator plus 50-100 years.
- ▶ **Justification: Obtaining a copyright**
 - ▶ Must meet minimal standard of originality
 - ▶ Copyright is automatically granted
 - ▶ Right based on originality rather than uniqueness
- ▶ **Exemptions for “fair use”**
 - ▶ Depends on % used; impact on copyrighted work



Patents

- ▶ A **patent** is exclusive right to inventor for a limited time in exchange for detailed public disclosure of an invention
 - ▶ Invention must be novel and non-obvious.
 - ▶ Patent allows one firm to block others.
 - ▶ Enforced via civil lawsuits; patent may be challenged.
 - ▶ Last 20 years from date of filing.
- ▶ Patent may cover
 - ▶ Business methods (e.g. Amazon's one-click)
 - ▶ Genetically modified organisms (e.g. Monsanto)
- ▶ Obtaining a patent
 - ▶ File with patent office. Cost \$10-30k.



Patenting Strategy

▶ Patents vs. Trade Secrets

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

▶ Which is better?

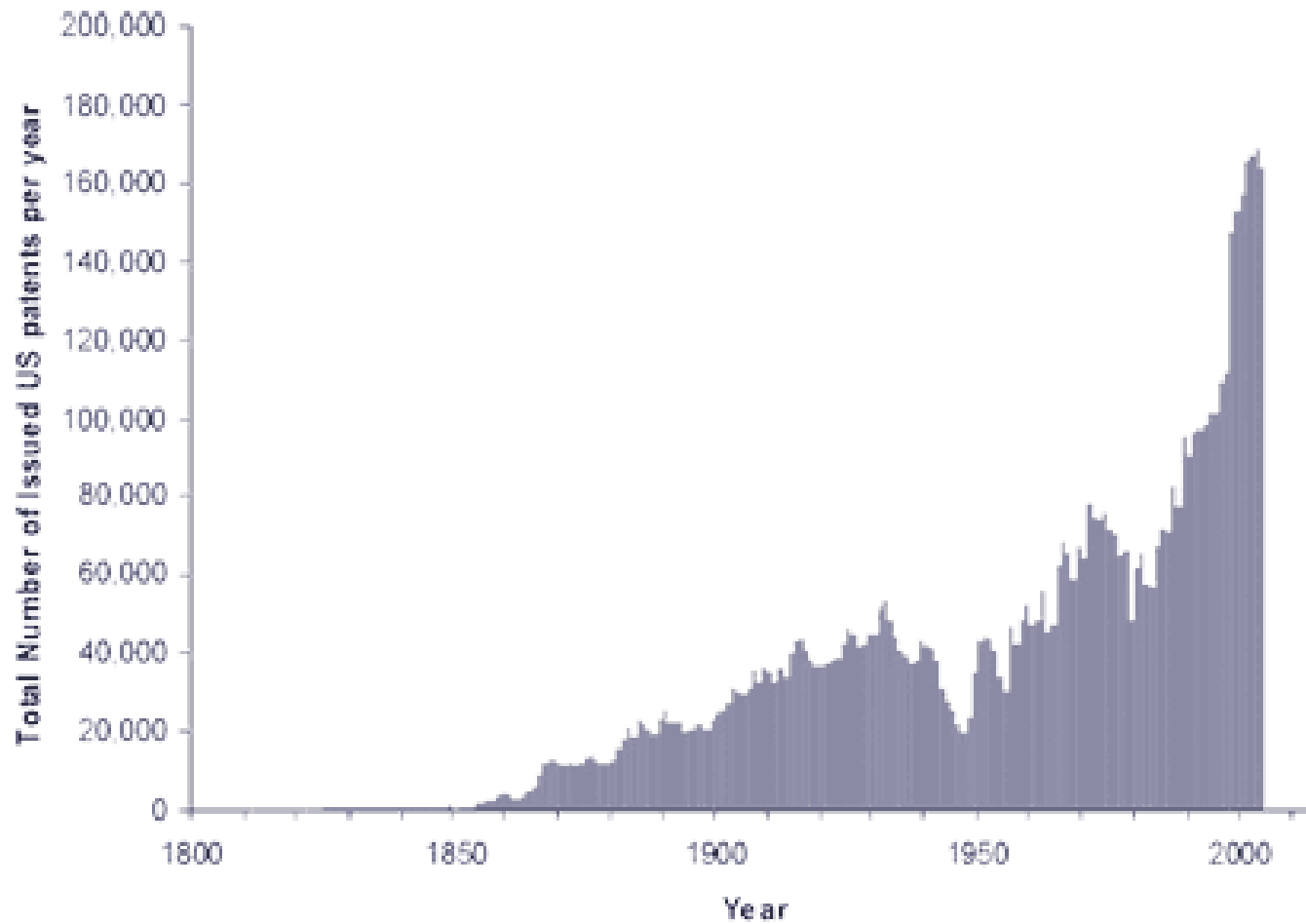
- ▶ Can the competition use information in patent disclosure?
- ▶ Can they get around the patent?
- ▶ Can they see through trade secrets?
- ▶ Do you wish to license or sell the idea?
- ▶ Do you wish others to improve on the idea?
- ▶ How quickly will returns come?

▶ 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.
 - ▶ Give away control rights (future sales, agreements)
 - ▶ 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.**
 - ▶ Who to fund?
 - ▶ What are their objectives?
- ▶ **Pull strategies - award winners.**
 - ▶ Give one prize or many? 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**

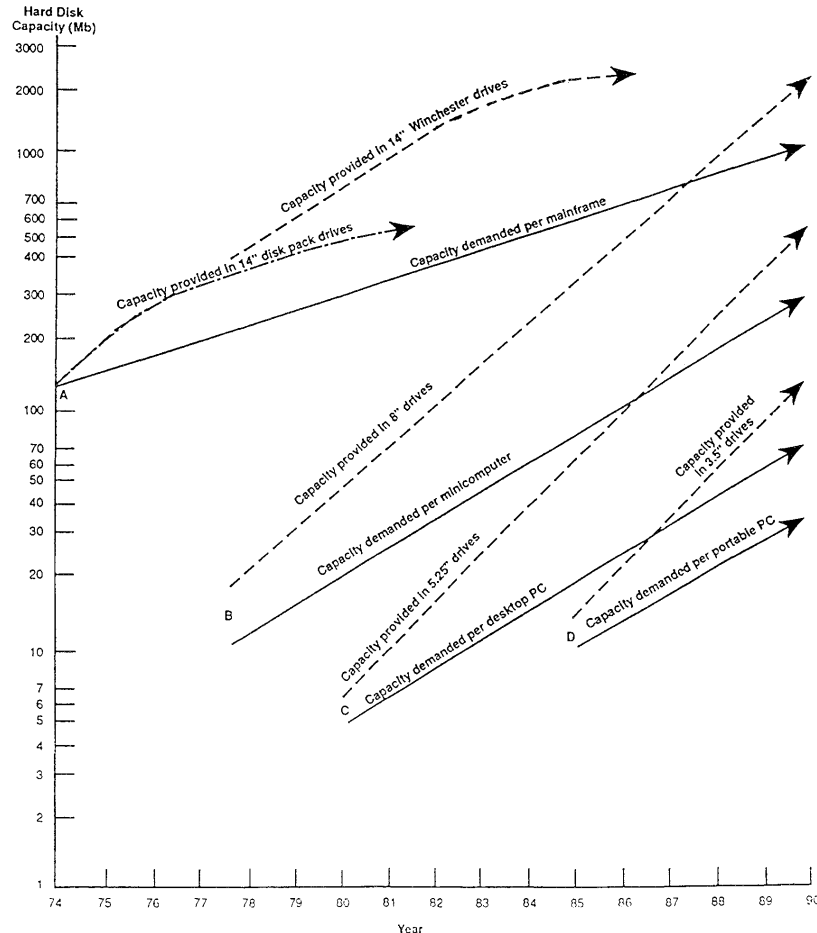
- ▶ Vertical improvements
- ▶ Doing the same, but better
- ▶ e.g. Thin film disks in Hard Drive industry.

- ▶ **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)

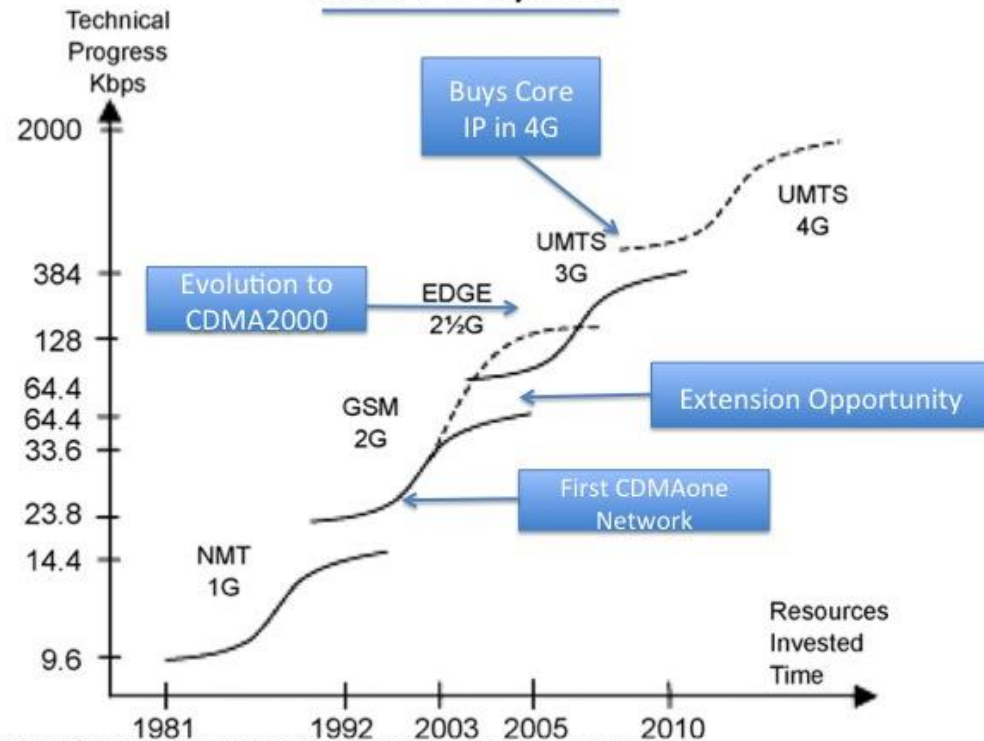
- ▶ Customer demand rises slower than technical progress



Disruptive technology takes over (2)

- ▶ S-curves mean decreasing speed of innovation

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



Source: Inter-generational transitions in socio-technical systems: The case of mobile communications

Leadership and Innovation

(a) Numbers of established and entrant firms introducing models employing selected trajectory-sustaining technologies

		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Thin-film heads	Entrants							1		1	2	1			1	4
	Established			1			1	1	3	5	6	8	12	15	17	22
RLL codes	Entrants											1	2	3	6	8
	Established											4	11	20	25	26
Winchester architecture	Entrants				1	4	9									
	Established	1		3	3	7	11									

(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	

- ▶ 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.
- ▶ Henry Ford: "If I'd ask customers what they wanted, they would have told me 'a faster horse'".

▶ 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.
- ▶ New customers, e.g. Compaq, making small desktops
- ▶ Rapid improvement in technology.
- ▶ Seagate entered market in 1987, but then too late.

Crowdfunding

What is it?

- ▶ **Examples**

- ▶ Kickstarter
- ▶ IndieGoGo

- ▶ **Crowdfunding increases efficiency of lending**

- ▶ Works in countries with limited banking
- ▶ Entrepreneurs can learn demand before undertaking project

- ▶ **Examples**

- ▶ Citizen star video game raised \$93m
- ▶ Pebble-time smart watch raised \$20m

- ▶ **Crowdfunding can be used to donate money**

- ▶ People can give to specific projects
- ▶ Can cut out middlemen

How does it (roughly) work?

▶ Rewards crowdfunding

- ▶ An entrepreneur posts price $p = \$100$ and target $T = \$10,000$.
- ▶ If raise less than T , everyone gets money back.
- ▶ If raise more than T , everyone pays p and (hopefully) gets good.

▶ Debt crowdfunding

- ▶ Entrepreneur requests loan size T and interest rate r .
- ▶ Lenders can choose to give money.
- ▶ If raises T , then money is lent; otherwise get refund.

▶ Equity crowdfunding

- ▶ Entrepreneur willing to sell 10% of company for \$10,000.
- ▶ Lenders can buy shares, so 1% costs \$1,000
- ▶ If raises T , then money is given; otherwise get refund

Moral hazard problem

- ▶ **How ensure firm doesn't run away with the money?**
 - ▶ Consider rewards-based product (e.g. video game)
- ▶ **Solution 1: require prototype**
 - ▶ Skarp raise \$4m on Kickstarter, but was suspended
 - ▶ Went over to Indigogo, where raised \$300k
- ▶ **Solution 2: deferred payment (e.g. PledgeMusic)**
 - ▶ Give firm target T immediately, so can build product.
 - ▶ Give all money raised after product finished.
- ▶ **Solution 3: Buyers put down non-refundable deposit**
 - ▶ Firm can use deposit money.
 - ▶ Can use future orders to get regular capital.
 - ▶ E.g. apartment buildings, which usually pre-sell 70%