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

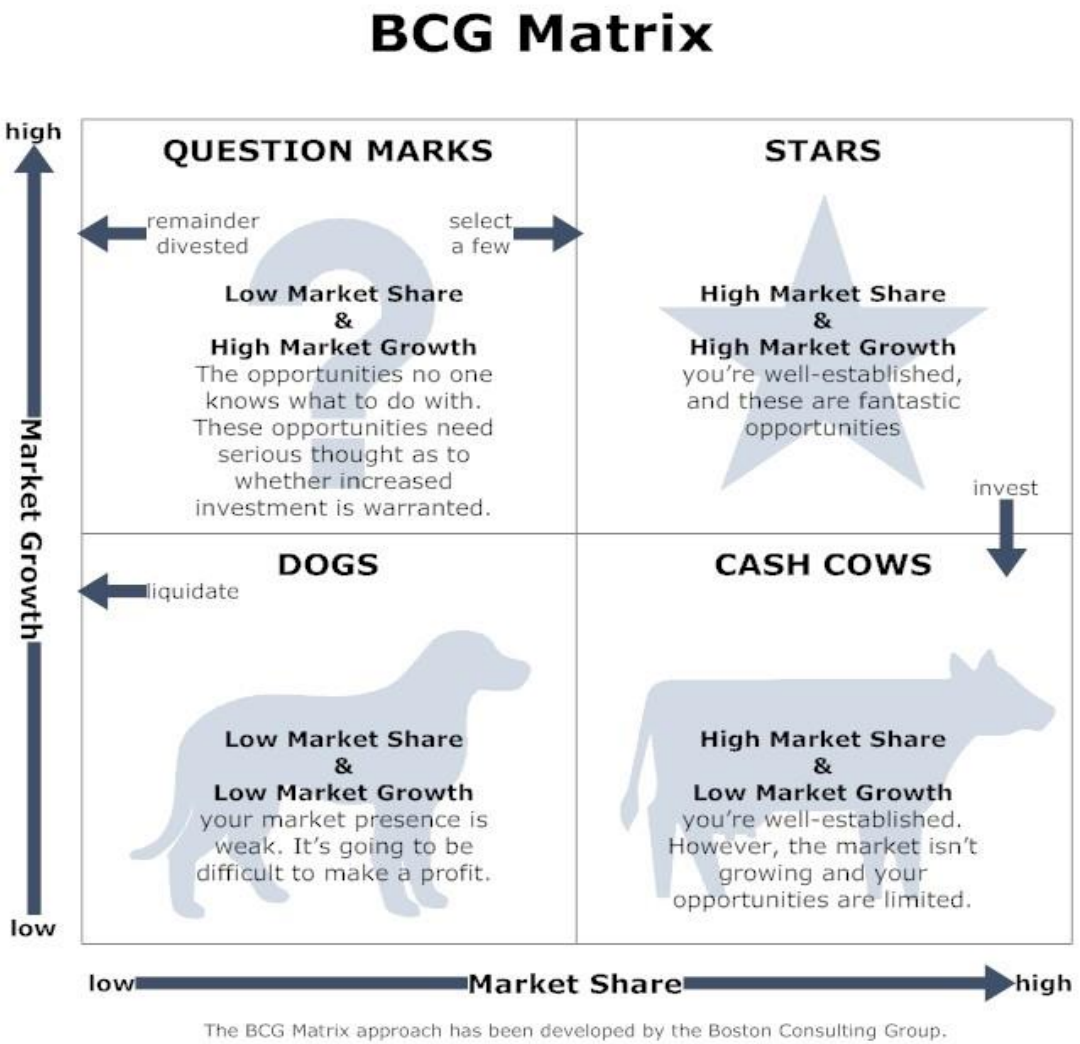
Phase 3: Maturity

- 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.

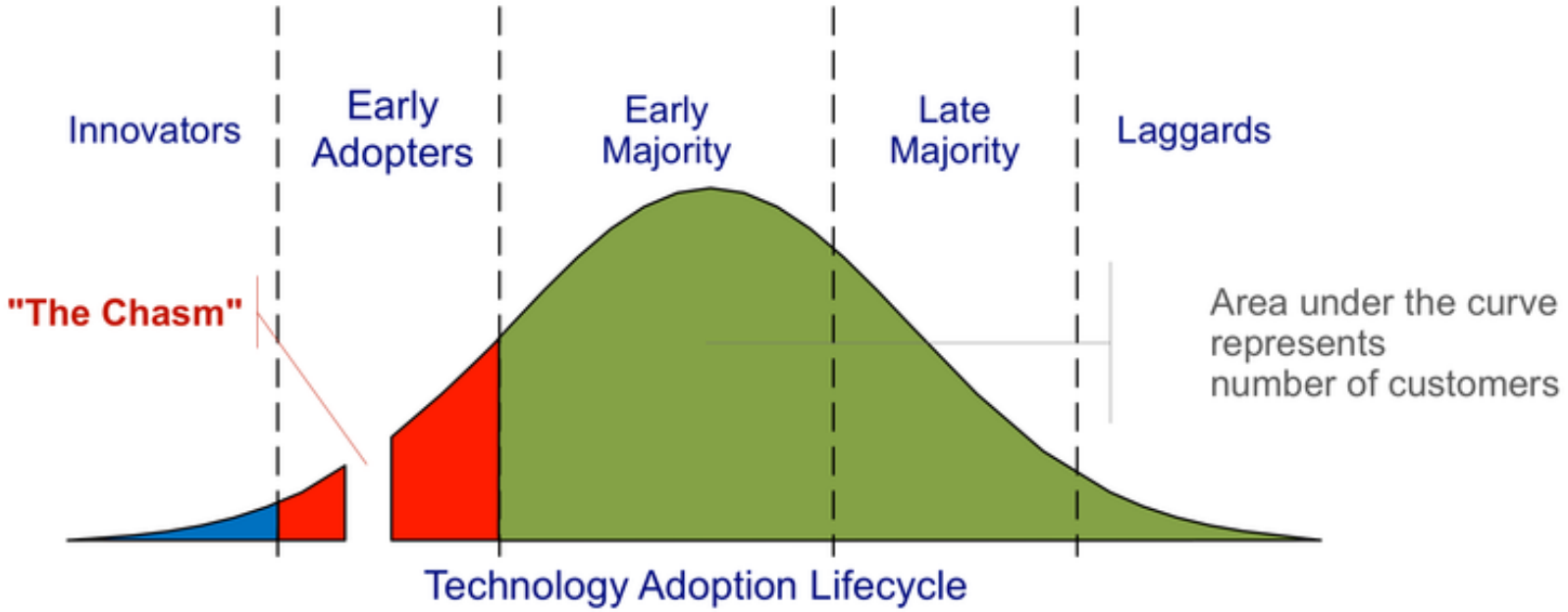
A Summary…

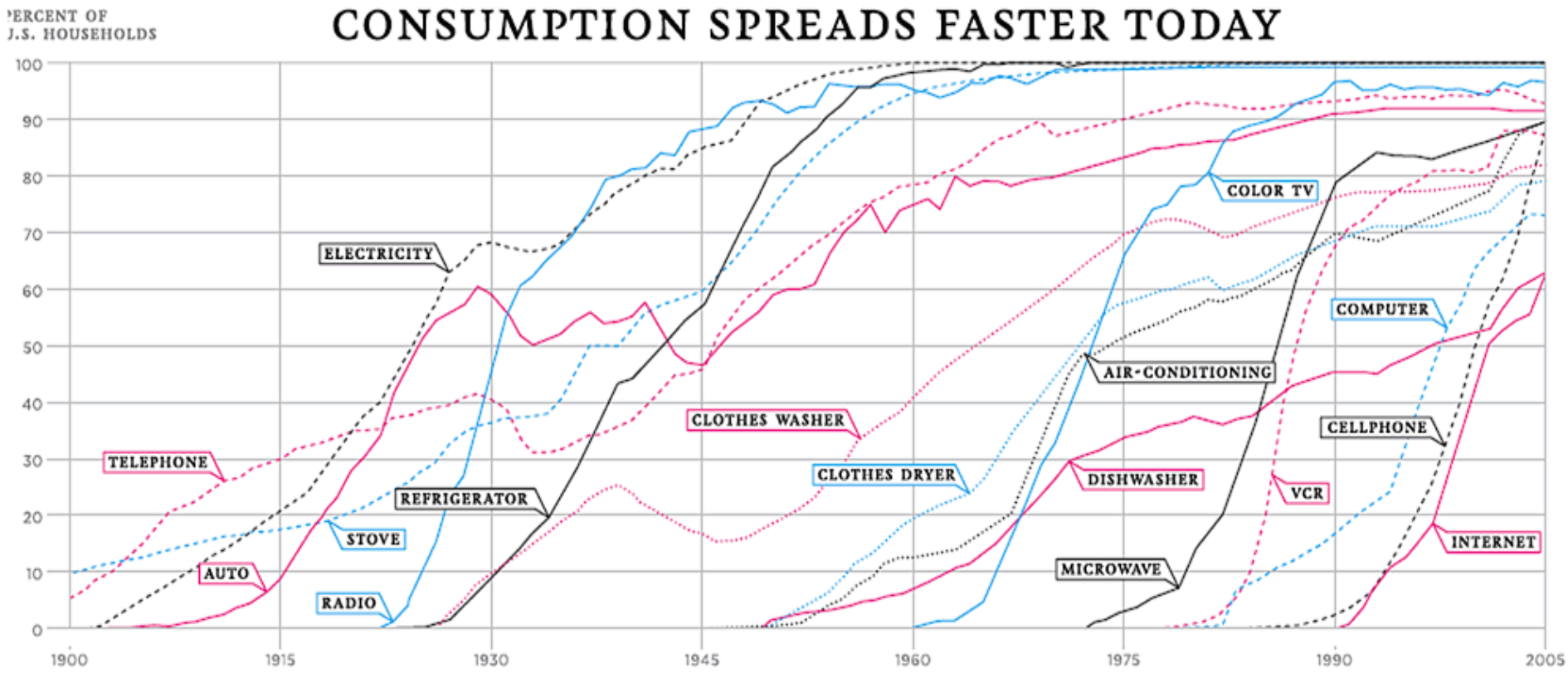

BCG Matrix
high
Market Growth
low
QUESTION MARKS
remainder divested
select a few
Low Market Share
&
High Market Growth
The opportunities no one knows what to do with. These opportunities need serious thought as to whether increased investment is warranted.
STARS
High Market Share
&
High Market Growth
you're well-established, and these are fantastic opportunities
invest
DOGS
liquidate
Low Market Share
&
Low Market Growth
your market presence is weak. It's going to be difficult to make a profit.
CASH COWS
High Market Share
&
Low Market Growth
you're well-established. However, the market isn't growing and your opportunities are limited.
low
Market Share
high
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


Innovators
Early Adopters
Early Majority
Late Majority
Laggards
"The Chasm"
Area under the curve represents number of customers
Technology Adoption Lifecycle


ERCENT OF
J.S. HOUSEHOLDS
CONSUMPTION SPREADS FASTER TODAY
100
90
80
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60
50
40
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10
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1900
1915
1930
1945
1960
1975
1990
2005
ELECTRICITY
TELEPHONE
REFRIGERATOR
STOVE
AUTO
RADIO
CLOTHES WASHER
CLOTHES DRYER
COLOR TV
AIR-CONDITIONING
DISHWASHER
MICROWAVE
COMPUTER
CELLPHONE
VCR
INTERNET

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, $(V - rc(T)) = \ [-c'(T)]$
- 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

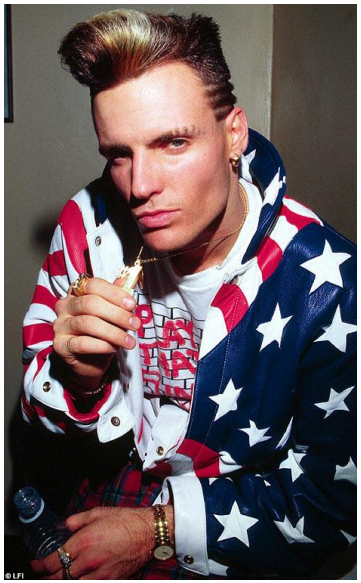
- A **trademark** is a phrase, symbol, or design that identifies a product, and distinguishes it from others.
  - Aim to stop customers from mixing up brands.
  - Strongest trademarks cover words that have no other meanings (Kodak), or are used in unusual way (Apple).
  - Not to prevent companies from 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



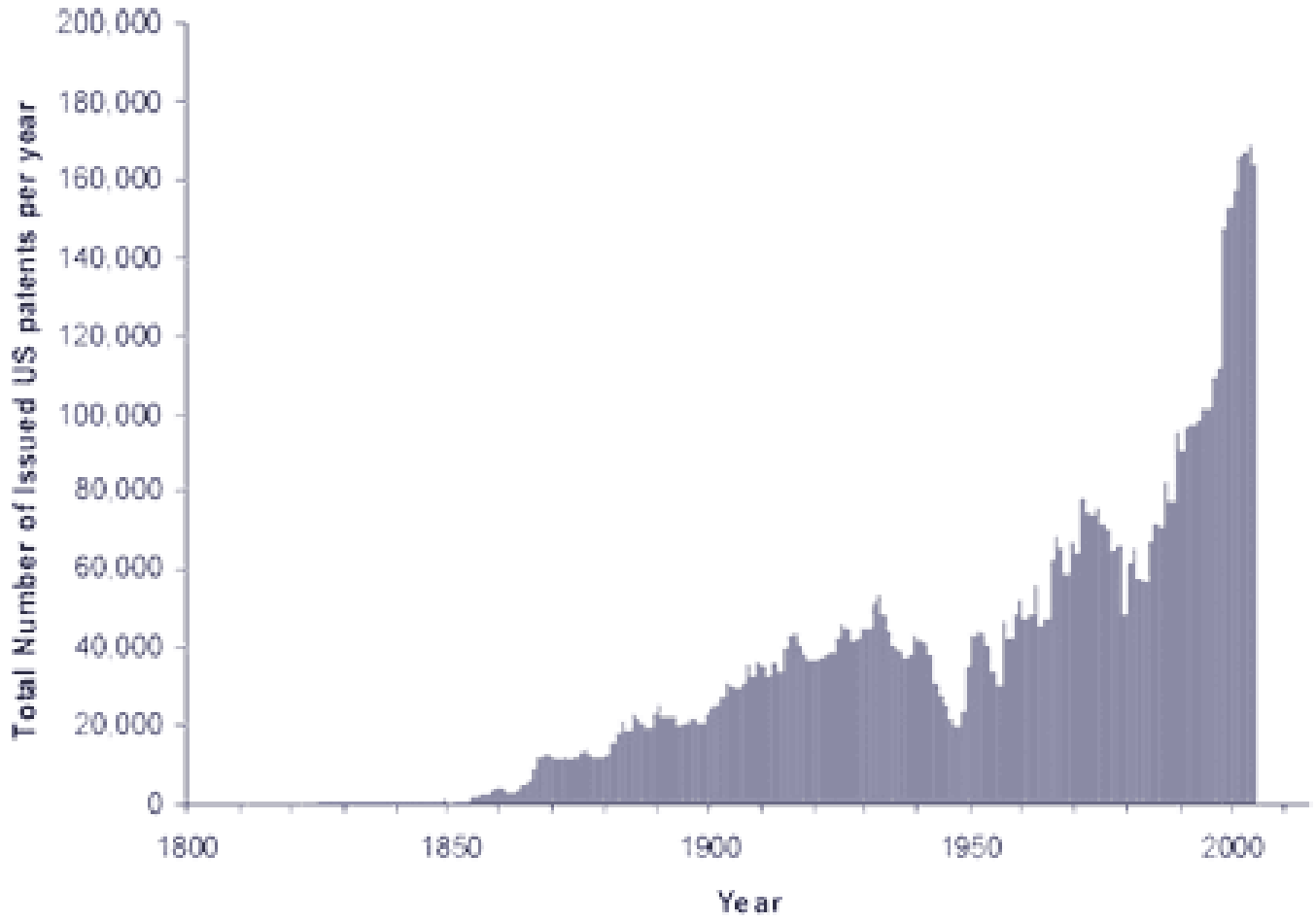
Patents

- 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.
  - Defends firm against lawsuits from competitor

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

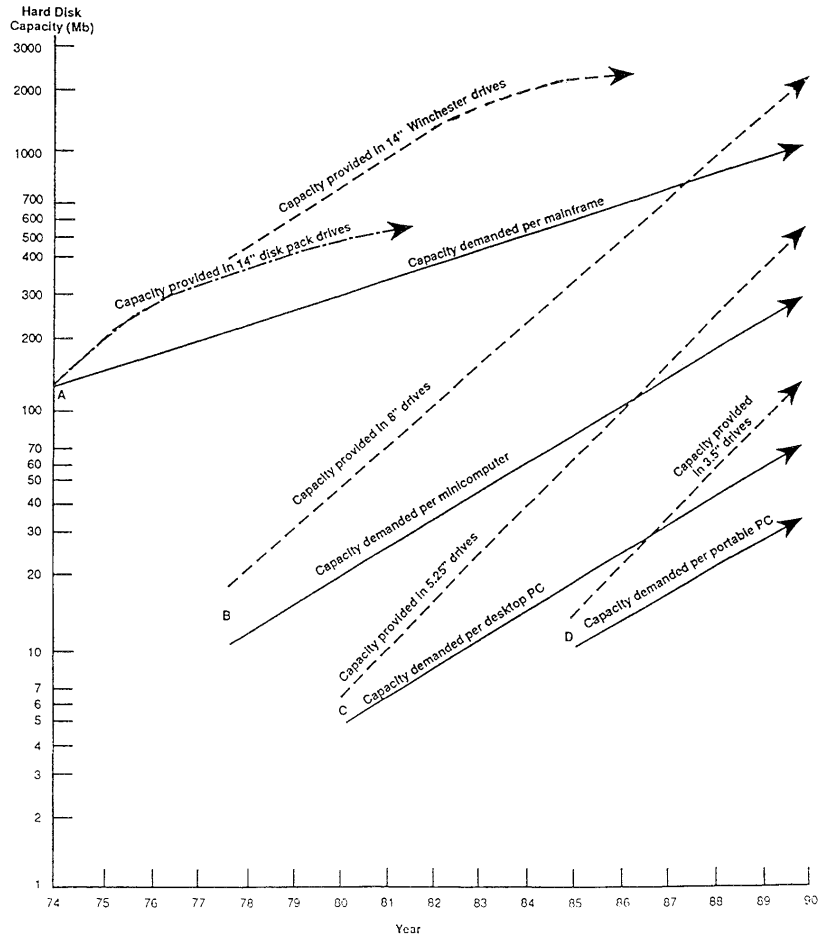
- Main frames – IBM
- Minicomputers – Digital Equip, Data General
- Desktop computers – Apple, Commodore, Tandy, IBM
- Engineering workstations - Apollo, Sun Microsystems
- Portable computers – Compaq, Zenith, Toshiba, Sharp
- Netbooks – Asus, Acer
- Tablets – Apple, Samsung

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

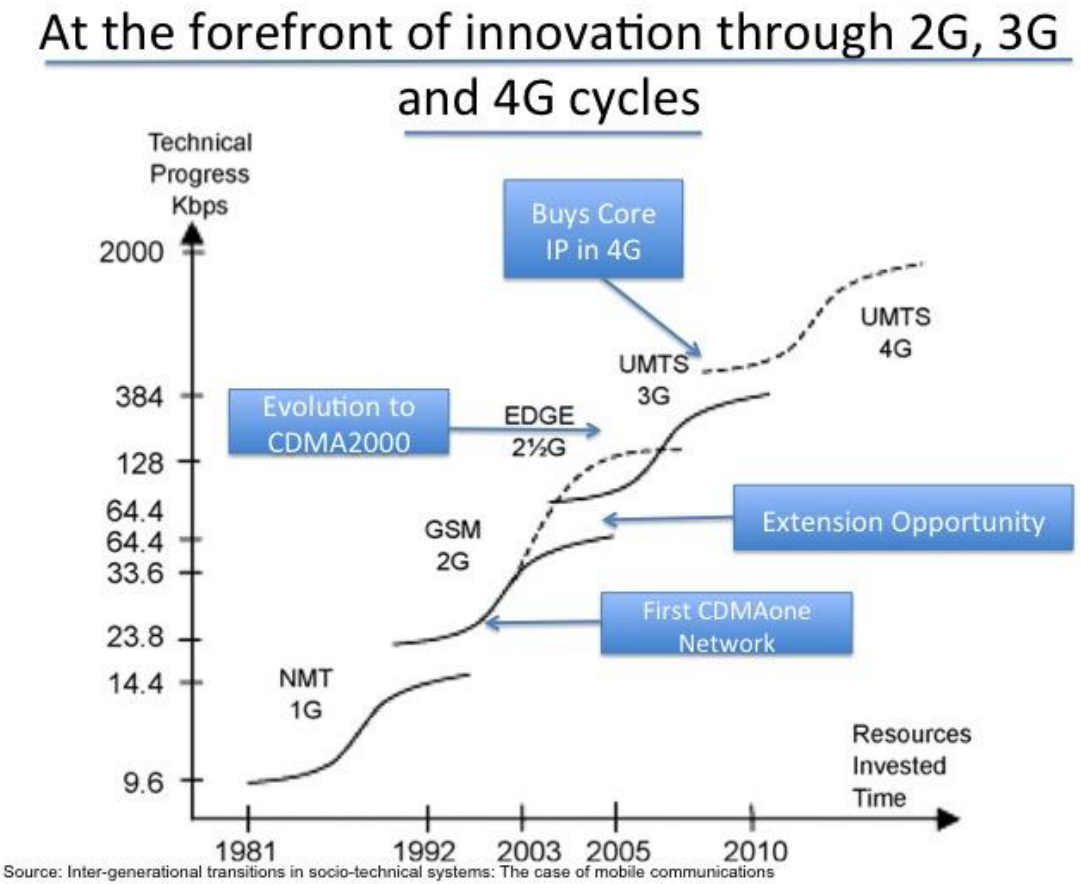
Disruptive technology takes over (1)

- Customer demand rises slower than technical progress



Disruptive technology takes over (2)

- S-curves mean decreasing speed of innovation



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,
  - ½ to ¾ 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%