The Economics of E-commerce and Technology
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.
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
Technology Adoption Lifecycle

- Innovators
- Early Adopters
- Early Majority
- Late Majority
- Laggards

"The Chasm"

Area under the curve represents number of customers
CONSUMPTION SPREADS FASTER TODAY

- ELECTRICITY
- TELEPHONE
- AUTO
- RADIO
- REFRIGERATOR
- STOVE
- CLOTHES WASHER
- CLOTHES DRYER
- DISHWASHER
- MICROWAVE
- AIR-CONDITIONING
- COLOR TV
- 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
  \[
  \frac{f(t)}{1 - F(t)} = p + q F(t)
  \]
  so the no. of new adopters is linear in the no of users.
- Solving this differential equation,
  \[
  f(t) = \frac{(p+q)^2 e^{(p+q)t}}{q e^{(p+q)t} + p}^2
  \]
- 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: 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.
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

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(b) Numbers of established and entrant firms introducing models based upon disruptive architectural technologies

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- Sustaining innovations
  - Leaders continued to dominate across generations
- Disruptive innovation,
  - $\frac{1}{2}$ to $\frac{3}{4}$ 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.