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.
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
The image illustrates the Technology Adoption Lifecycle, which is divided into several segments: Innovators, Early Adopters, Early Majority, Late Majority, and Laggards.

A notable section labeled "The Chasm" highlights the transition between Innovators and Early Adopters. This area is often emphasized in discussions of technology adoption, as it represents a significant gap that can be a barrier for technology adoption.

The area under the curve represents the number of customers adopting the technology throughout its lifecycle.
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
  \[
  \frac{f(t)}{1 - F(t)} = p + qF(t)
  \]
  so the no. of new adopters is linear in the no. of users.
- Solving this differential equation,
  \[
  f(t) = \frac{(p+q)^2 e^{(p+q)t}}{(qe^{(p+q)t} + p)^2}
  \]
- 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.
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.
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 $R$, then money is lent; otherwise get refund.

- **Equity crowdfunding**
  - Entrepreneur willing to sell $x\%$ of company for $T$.
  - Lenders can buy shares, so $1\%$ costs $1/T$
  - 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%