The Evolution of Markets and Patterns of Technology Changes

Outline

- Rate of technology development and transitions between technologies
- Rate of adoptions (diffusion and substitution) and adopter categories
- CT scanner -- discuss both issues

- Project?
  - What are your tech. development issues, what is your S-curve
  - Who are your lead users, what are their needs
Rate of technology maturity

Incremental break-through: S-curve
Factors in technology development

- **Technology limitations**: What is the maximum capability of a given technology?
- **Slope of the curve**: Want to select technologies that are improving more rapidly.

**Development Time**: How long will it take to get the technology ready.

**Performance/size** vs. **Time/effort/$**

- **Vacuum Tubes**: Medium scale integration
- **Transistors**: Large scale integration

Graph illustrating technology dispersion over time.
Risks in technology adoption

- Technology limitations
- Development Time
- Ideal Transition Time
- Start adopting new technology

Efficiency vs. Effectiveness

- Efficiency -
  - How fast can you get up the curve
  - Incremental improvements
- Effectiveness -
  - What is the right curve to be on

- Real options
  - Need to buy the option to develop a new technology to give you the right to enter a new market at a later date.
Within a single technology

Product innovation

Process innovation

<table>
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<tr>
<th>functional</th>
<th>cost</th>
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<tr>
<td>competitive</td>
<td>competitive</td>
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Flexibility

dedicated equipment

Comparison of types

- Small innovator
  - Functional competition
  - market not defined
  - flexible
  - rapid change
  - early innovations return a larger profit (consistent with risk/return curve)
  - product focused
  - ill-defined targets

- Large established org.
  - Market defined
  - clear customer needs
  - easy comparison between companies
  - cost driven - economies of scale
  - incremental improvement
  - process focus
  - clear targets
Rate of adoption

• There is an “S-curve” for diffusion and substitution
  – Diffusion - rate at which new users are created
  – Substitution - rate at which existing users switch products

Diffusion rate

• Diffusion of technology is preceded by the diffusion of information
• Diffusion and substitution is a function of the number of people using a product (network effect)
Equations

- $\frac{dN}{dt} = P(t)(N_t-N)$
  - $P(t)$ probability that a new person will change from old to new
  - $(N_t-N)$ - number of remaining customer
- $P(t) = kN$
  - $N$ = number of other customer (numbers of signals)
  - $k$ = effectiveness of a message
- $\frac{dN}{dt} = kN(N_t-N)$

Rapid dispersion

- Need to get the value of $k$ high for the early adopters. I.e., target those adopters who have the best voice and can create the most effective message.
Graph of adoption

Adopter categories

- Innovators
  - High risk, lots of capital
  - Bring the idea in
- Early adopters
  - Opinion leadership
  - Role models
- Early majority
  - Not leaders
- Late majority
  - Skeptics
- Laggards
  - Traditional
  - “devil-you-know”
Why was this a classic new technology?

- Classic S-curve on technology
- Don’t know customer needs
- Market numbers are way off
  - first prediction 5 per year - Pfizer expected to sell 240 per year several years later
  - even later, no clear market size ranging from 120M - 1B
- Change from function to $ (govt. regulation effected this)
- Change from diffusion to substitution

What drove diffusion?

- Getting lead neurologists to use the machine
- Create it as a status symbol (every one need their own CT scan even though others had one nearby and it was underutilized)
- Create it as a technology for researchers (many journal articles on the new area)
- Have the customer want it (i.e., no one would consider having brain surgery without a CT scan first). Ethically driven to use a CT scan before surgery.
- Radiology was a money making division.
- First sales people were the technologists and a top neurologist
Profits?

- Why was the scanner initially so profitable? Is this likely to continue?
- Early profitability came from no competition. Top research hospitals have large budgets for a technology that allows what they couldn’t see before.
- Low investment (relatively) because they used outside vendors -- no need to purchase capital equipment
- Later pressure came from customer demands, competition

Change in emphasis

- Early was to get the functions out
- New
  - Still getting the times down and resolution up
  - Quality issues
  - Delivery schedules
  - Reliability
  - Cost
- Complexity in the organization
  - Politics, large teams, sales force
Why was their idea appropriable?

- Did not defend with patents
- Other medical companies had the expertise to get going quickly on the product once the technology was demonstrated (had all of the infrastructure in place)

S-curve for the CT scanner

- Early
  - Trying to get it to work
- Mid
  - Major change in rates, technologies
  - Added features
- Late
  - Minor changes to get time down
Final wrap up question

• What strategy would you recommend EMI pursue? Why?

Next lecture - Impact of NT on PD

• New Product Development at Cannon,
• EMI and the CT Scanner (A)
• How do different companies develop new technology? What are the different strategies? What are the benefits and problems with each approach?
• What were the key technology risks in each case and how each company address them?
• What are the risks involved in new technology and what methods are used to mitigate them?
• Organizational effects on new technology introduction?
Written Assignment 1 due

• Review assignment