Design Evaluation
Demand Forecasting
“The art of prophecy is very difficult – especially with respect to the future.”

Mark Twain
40% of New Products Fail

- No Basic Need for Product
- Overall Product Does Not Meet Need
- Idea Not Properly Communicated
Mortality of New Product Ideas
The Decay Curve

Number Of Ideas

Time
What it takes

- A system or process to weed out projects
- An understanding of how innovations are embraced
Product Adoption Patterns

- **Innovators**: 2.5%
- **Early Adopters**: 13.5%
- **Early Majority**: 34%
- **Late Majority**: 34%
- **Laggards**: 16%

Time Until Adoption
Early Adopters

- Hi Education, Income, Status, Literacy
- Empathy, Less Dogmatic, Ability to Abstract, Rational, Intelligent, Able to Cope with Risk, Aspiration, Positive Attitude to Science,
- Social Participation, Media Exposure, Information
- No Relationship to Age
Innovation vs. Imitation

- Innovators are not influenced by who already has bought
- Imitators become more likely to purchase with more previous buyers
Probability of Purchase by New Adaptor in Period $t$

\[ p + q \cdot \frac{K^t}{M} \]

- $p$ = Probability of Purchase without influence by adopter
- $q \cdot \frac{K^t}{M}$ = Probability of Purchase through Influence by Adopter

\[ M = \text{Market Size} \]
\[ K = \text{Cumulative number of adopters before period } t \]
\[ q = \text{Effect of each Adopter on each Nonadopter} \]
\[ (\text{Coefficient of Internal Influence}) \]
\[ p = \text{Individual Conversion w/out influence by Adopters} \]
\[ (\text{Coefficient of External Influence}) \]
The Bass Model

\[ Q_t = p \cdot (M - K_t) + q \cdot \frac{K_t}{M} \cdot (M - K_t) = \left( p + q \frac{K_t}{M} \right) \cdot (M - K_t) \]

**Imitation Effect or Internal Influence**

**Innovation Effect or External Influence**

- \( Q_t \): Number of adopters during period \( t \)
- \( M \): Market Size
- \( K_t \): Cumulative number of adopters before period \( t \)
- \( q \): Effect of each Adopter on each Nonadopter
  - (Coefficient of Internal Influence)
- \( p \): Individual Conversion w/out influence by Adopters
  - (Coefficient of External Influence)
Cumulative Sales for Different $p, q$ Parameters

- $p = 0.5, \quad q = 0.0001$
- $p = 0.1, \quad q = 0.1$
- $p = 0.01, \quad q = 0.25$
- $p = 0.001, \quad q = 0.5$
Cumulative Sales for Different $p,q$ Parameters

- $p = 0.5, \quad q = 0.0001$
- $p = 0.1, \quad q = 0.1$
- $p = 0.01, \quad q = 0.25$
- $p = 0.001, \quad q = 0.5$
Diffusion Curve For Refrigerators
1926-1979

Market Penetration

Time


p = 0.025, q = 0.126
Diffusion Curve For Calculators
1973-1979

Market Penetration

Time


0% 20% 40% 60% 80% 100%

p = 0.143, q = 0.52
Diffusion Curve For Power Leaf Blowers, 1986-1996

\[ p = 0.013, \quad q = 0.315 \]
Diffusion Curve For Cell Phones
1986-1996

\[ p = 0.008, \quad q = 0.421 \]
Example: Satellite Radio

- Roughly 160 million potential listeners
- Phone Survey (6,000)
  - 96 million not willing to pay fee
  - Interested, given costs [million]

<table>
<thead>
<tr>
<th>Radio [$]</th>
<th>12</th>
<th>10</th>
<th>8</th>
<th>5</th>
<th>2</th>
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<tbody>
<tr>
<td>400</td>
<td>23.7</td>
<td>27.4</td>
<td>27.5</td>
<td>27.6</td>
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<td>24.8</td>
<td>28.5</td>
<td>28.7</td>
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<tr>
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<td>31.2</td>
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<td>200</td>
<td>31.5</td>
<td>36.5</td>
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<tr>
<td>150</td>
<td>35.6</td>
<td>41.6</td>
<td>44.1</td>
<td>49.1</td>
<td>53.0</td>
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<tr>
<td>100</td>
<td>45.7</td>
<td>54.0</td>
<td>58.7</td>
<td>68.3</td>
<td>77.8</td>
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</table>

Source: E. Ofek, HBS 9-505-062, 2005
Analog Products

<table>
<thead>
<tr>
<th>Product</th>
<th>p</th>
<th>q</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portable CD Player</td>
<td>0.0065</td>
<td>0.66</td>
</tr>
<tr>
<td>Auto Radio</td>
<td>0.0161</td>
<td>0.41</td>
</tr>
<tr>
<td>Cellular Phone</td>
<td>0.008</td>
<td>0.42</td>
</tr>
</tbody>
</table>

Source: E. Ofek, HBS 9-505-062, 2005

Factors For Assessing Analogies

- Product Characteristics
- Market Structure
- Buyer Behavior
- Marketing Mix
Deriving M, p, & q from Data

\[
Q_t = p \cdot (M - K_t) + q \cdot \frac{K_t}{M} \cdot (M - K_t) = \left( p + q \frac{K_t}{M} \right) \cdot (M - K_t)
\]

\[
= pM + (q - p) \cdot K_t - \frac{q}{M} \cdot K_t^2
\]

\[
= a + bK_t - cK_t^2
\]

Compute \( a, b, \) and \( c \) with Ordinary Least Square Regression, given actual sales data.

\[
p = \frac{a}{M}
\]
\[
q = -mc
\]
\[
M = -b \pm \frac{\sqrt{b^2 - 4ac}}{2c}
\]

Commercial Software

- [www.mktgeng.com](http://www.mktgeng.com)
- [www.basseconomics.com](http://www.basseconomics.com)
Limits of the Bass Model

- Static market potential
- Static geographic boundaries
- Independence of other innovations
- Simple “not adopt to adopt” framework
- Limitless supply
- No repeat or replacement sales
- Individual decision process neglected
- Deterministic
Roger’s Five Factors

► Relative Advantage
  ▪ Product performance relative to incumbent

► Compatibility
  ▪ Consistency with existing values/experiences

► Complexity
  ▪ Ease of Use

► Triability
  ▪ Possibility to experiment with product

► Observability
  ▪ Visibility of usage and impact
Example: Segway

- Relative Advantage
- Compatibility
- Complexity
- Triability
- Observability
Example: Viagra

- Relative Advantage
- Compatibility
- Complexity
- Triability
- Observability
A-T-A-R

- **Awareness**
  - Who is aware of the product?

- **Trial**
  - Who wants to try the product?

- **Availability**
  - Who has access to the product?

- **Repeat**
  - Who wants to try product again?
The A-T-A-R Model

Units Sold = Market Potential

* Percentage aware
* Percent who try
* Percent who have access
* Percent who will repeat
* Number of repeats per year
## Sources for A-T-A-R Data

<table>
<thead>
<tr>
<th>A-T-A-R Data</th>
<th>Basic Market Research</th>
<th>Concept Test</th>
<th>Product Use Test</th>
<th>Component Testing</th>
<th>Market Test</th>
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<td>Market size</td>
<td>Best</td>
<td>Helpful</td>
<td>Helpful</td>
<td>Helpful</td>
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<tr>
<td>Awareness*</td>
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<td>Availability</td>
<td>Helpful</td>
<td></td>
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<td>Best</td>
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</tr>
<tr>
<td>Repeat</td>
<td>Helpful</td>
<td>Helpful</td>
<td>Best</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Often estimated by ad agency

Concept Test
(non tangible product)

► Weed out poor ideas

► Gauge Intention to purchase
  ▪ (Definitely (not), Probably (not), Perhaps)
  ▪ Respondents typically overstate their willingness to purchase
  ▪ Rule of thumb, multiply the percentage responding
    ► Definitely would purchase by 0.4
    ► Probably would purchase by 0.2
    ► Add up: The result is the % for trial

► Learning
  ▪ Conjoint Analysis
Product Use Test
(“tangible” product)

- Use under normal operating conditions
- Learning
  - Pre-use reaction (shape, color, smell…)
  - Ease of use, bugs, complexity
  - Diagnosis
- Beta testing
  - Short term use tests with selected customers
  - Does it wor?
- Gamma testing
  - Long term tests (up to 10 years for med.)
Market Test

- Test product *and* marketing plan
- Test Marketing
  - Limited Geographies (waning importance)
- Pseudo Sale, Controlled Sale, Full Sale
- Speculative Sale
  - Full pitch with all conditions
- Simulated Test Market
  - Stimuli, play money, pseudo store
  - 300 – 600 Respondents, 2-3 months, $50k to $500k
Additional Reading

► E. Rogers: “Diffusion of Innovations”,

► G. A. Moore: “Crossing the Chasm”
  - 3rd Edition 2002

► M. Crawford & A. Di Benedetto,
  “New Products Management”,

► G. Lilien, P. Kotler, & K.S. Moorthy
  “Marketing Models”
  - 1992, (fairly technical, limited availability)
Tomorrow

► Industry Leaders in Technology and Management Lecture

► James Dyson
Next Thursday

► Simon Pitts from Ford Motor Company
► Professional Behavior
  ▪ Please be on Time!!!
► No TAs on site