Technology Assessment and Acquisition

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Technology assessment/acquisition is one of the strategic tasks to which today’s companies from all industries pay more attention than ever before. The subject covers a wide range of topics from technology evaluation issues to selection methodologies. Evaluating technologies require multidimensional analyses. These dimensions include organizational structure, human interface, marketing structure, product development strategies, and innovation diffusion patterns. There are of course several other dimensions that could be derived. The course objective is to accomplish to identify several dimensions of technology assessment and acquisition through many case studies, professional and research articles, guest speakers from local companies, and recently published books.
1. **CLASS MATERIAL**

1.1 **TEXTBOOKS**


1.2 **CASES**

ToyWorld, Inc.: Information Technology Planning. Product#: 195262

General Electric Medical Systems—2002, Product#: 702428

Intel Capital: The Berkeley Networks Investment, Product#: 600069

Intel Research: Exploring the Future, Product#: 605051

IBM On Demand Community, Product#: 504103

IBM Technology Group, Product#: 600010

Samsung Electronics and LCD Technology (A), Product#: 904M46

1.3 **OTA REPORTS**

http://www.wws.princeton.edu/ota/
2. GRADING AND EXPECTATIONS

Cases 30% 3/7 Reports Individual
Article Discussion 20% 2 Presentations Individual
Project Presentations 20% Presentation Team
OTA Report Review 15% Presentation Team
Final Report 15% Academic Paper Team
TOTAL 100%

2.1 CASES:

Each student is required to prepare 3 cases. Case reports are due the day of the discussion, no exceptions. You can use Harvard Business School’s Guide for cases. You are required to add value instead of providing summary. Include analyses done by methods discussed throughout the class. Conclusions, discussion and recommendation should be given attention. Details of implementation need to be discussed.

<table>
<thead>
<tr>
<th>Summary (20)</th>
<th>Analysis (30)</th>
<th>Implication (30)</th>
<th>Structure (10)</th>
<th>Lesson Learned (10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview the details</td>
<td>Point out critical issues</td>
<td>Link to the course content</td>
<td>Analyze and discuss critical issues with appropriate approach or method</td>
<td>Bring critical issues up to date</td>
</tr>
<tr>
<td>10 (min 5)</td>
<td>10 (min 5)</td>
<td>10 (min 7)</td>
<td>10 (min 5)</td>
<td>10 (min 9)</td>
</tr>
</tbody>
</table>

Case Example: key messages, references, analysis, conclusions
2.2 ARTICLE DISCUSSION:

Introduction

Compact disc technology is a good example of a disruptive technology. This case study looks at how the Consumer Electronics Group at Philips N.V. of the Netherlands studied different user scenarios in order to strategize how to break compact disc usage into the consumer music market. Analog LP technology had been in use for decades and although the quality of sound was good, at least in its early years, the mechanical process of scanning an entire recording onto vinyl was fraught with error, and the mechanical playback method (the needle on the rim of the record) as it met the record’s LP) introduced was on the record, reducing the quality of the sound ever recorded playback.

Philips is a worldwide company that had its start in the Netherlands in 1891. It has always been an innovative company, and over the years, it has evolved from a light bulb company created by Frederick and Gerard Philips, to medical equipment, radio, television, consumer electronics, music (the Philips monochromatic), VCRs (the world’s first), CD ROMs, and now, today it’s web site itself as one of the world’s top three consumer electronics companies, and Europe’s top consumer electronics company.

Case Summary

At the end of the 1970s, Philips was looking for ways to market its compact disc (CD) technology. Although the company did not develop the technology (early research was conducted at MIT in the 1950s) by the 1980s engineers in the Research Laboratories began looking at potential applications. By the early 1980s, the Consumer Electronics Group developed the first video prototype based on optical scanning over analog images of a disc. Despite the superior playback quality, the disc did not really catch on due to its playback-only capability. During this time, most companies were interested in video, and the VCR, which not only could play her recorded movies, another drawback to technology acceptance was the cost of CDs versus tapes. Like any new technology, CD ROMs were relatively expensive (players and discs) compared to tapes and VCRs. At the end of 1984, Alice Hackett, the marketing executive, said that it was good enough if it was priced right and could penetrate the market.

Also, during this time several companies in Europe and Japan had developed digital audio products. A question of standardization arose, because if several incompatible formats arose at the same time, it was feared that this would damage future markets.

Figure 1: Future Scenarios for Adoption of Digital CD Format in the Music Industry

```
<table>
<thead>
<tr>
<th>Scenario</th>
<th>Eventual Outcome</th>
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</thead>
<tbody>
<tr>
<td>Techno-Limited</td>
<td>Techno-Limited</td>
</tr>
<tr>
<td>Present Day</td>
<td>Present Day</td>
</tr>
<tr>
<td>CD-Impaired</td>
<td>CD-Impaired</td>
</tr>
<tr>
<td>Cahro-Typical</td>
<td>Cahro-Typical</td>
</tr>
<tr>
<td>Public Acceptance</td>
<td>Public Acceptance</td>
</tr>
<tr>
<td>Consumer Acceptance</td>
<td>Consumer Acceptance</td>
</tr>
<tr>
<td>Production cost</td>
<td>Production cost</td>
</tr>
<tr>
<td>Public Acceptance</td>
<td>Public Acceptance</td>
</tr>
<tr>
<td>CD-Impaired</td>
<td>CD-Impaired</td>
</tr>
<tr>
<td>Cahro-Typical</td>
<td>Cahro-Typical</td>
</tr>
</tbody>
</table>
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We see four in the Techno-Limited scenario, the technology integrates in high but public acceptance is low. Some reasons that public acceptance may be low are due to cost and lack of interest in change from cassette tapes to CDs. In the Present-Day scenario, the technology is at an early stage, and due to the lack of standards, technology integration for this application was low. For reasons stated above, public acceptance never grew. For the Techno-Limited scenario, at some point in the future, the public uses the technology and the technology matures so that the format is both broad and available. For the Grass-Roots scenario, the public is aware of the presence of the technology, but the will of industry isn’t there to develop the standard. It is an expensive proposition for industry, having to set up facilities and press plants and making sure all industry players are in agreement about the technology and would agree to use Philips royalties for development of the standard.
Each student will prepare 2 or 3 papers for discussion in class. You are expected to provide the key messages of the article and a critique of it. 3rd presentation will be assigned to those who want to make up for any lower grade. This deliverable will be in the form of verbal discussion.

<table>
<thead>
<tr>
<th>Grading for the Article</th>
<th></th>
</tr>
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<tbody>
<tr>
<td>Key Messages out of the article</td>
<td>25%</td>
</tr>
<tr>
<td>Relevance to Class Material</td>
<td>25%</td>
</tr>
<tr>
<td>Strengths and Weaknesses of the Paper</td>
<td>25%</td>
</tr>
<tr>
<td>Application potential of the paper</td>
<td>25%</td>
</tr>
</tbody>
</table>

Example:

**Article 21- Value Roadmapping: A Structured Approach for Early Stage Technology Investment Decisions**

To make decisions in the early stage technology development is highly important since there are many uncertainties. To make decisions, managers are already using some techniques such as discounted cash flow, real option techniques, decision trees etc. However, all these techniques are based on quantitative data. At the early stage of technology development, use of these techniques is not very effective since there is more qualitative data than quantitative.

In this article, they discuss an alternative method called “Value Roadmapping”. They suggest using VRM to improve technology valuation. The paper is based on some cases and it is still in progress. They say, VRM approach brings together a number of different perspectives relevant to the valuation and evaluation of individual projects, such as decision tree / option approaches, technology roadmaps and standard valuation techniques such as net present value (NPV).

Value roadmap concept consists of 4 different layers; market&business trends&drivers, value streams, barriers&enablers, technology capabilities. Value streams layer has 6 subcategories; products, services, businesses/facilities, cost/risk reduction, strategic position. The value streams layer is defined as future revenue streams arising from technology capability together with strategic impact. VRM process is typically conducted as a workshop or set of workshops with both technical and commercial people involved. This approach is aimed at individual projects or programs, and is not directly applicable to a portfolio of disparate projects, although the output from the VRM could be an input to existing techniques such as portfolio management.

VRM approach is based directly on the concepts and methods developed the basis of the foundation by T-plan. Also, it is based on applied research on how to initiate and customize the TRM method. In the paper, they say they will corroborate their findings with other existing roadmapping techniques such as TDE. Also, the their future research will be aimed to sharpen the VRM architecture and process.

**2.3 TEAM PROJECT:**
Each team will pick a technology for assessment. Technologies will be picked from those assessed by OTA: http://www.wws.princeton.edu/ota/ns20/pubs_f.html. Teams need to adopt the technology to solve a current day problem. Teams will make 4 presentations and prepare a final report:

1. Gap Analysis  
   5% of total grade

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### Airline Security

**Current Problems**

- Airports not compatible across system
- Airports not screening to same level
- Inefficient (i.e. long lines)
- Changing Federal Standards
- Staffing inadequacies
- Passenger Profiling

**Needs**

- **Technical**
  - Easily incorporated into current systems
  - Robust/Reliable
  - Easy to Modify
- **Organizational**
  - Approved by FAA
  - User Friendly
  - Economically Feasible
- **Personal**
  - Feel Safe
  - Minimize delays/ waiting time
  - Minimize discrimination

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### Airline Security

**Capabilities**

- **Technical**
  - Explosive Detection Systems
  - Passenger/Baggage Reconciliation Systems
- **Organizational**
  - Awareness of gaps
  - Increased Vigilance
  - Federal Employees (higher human level of training)
- **Personal**
  - Ongoing investigations of new technologies
  - Strive for “safe” feeling

**Gaps**

- **Technical**
  - Candidate Technologies tested but not proven
  - Smaller systems or larger buildings needed
  - Higher capacity systems
- **Organizational**
  - Cooperation between Port Authorities and Federal government
  - Slow Economy (limited resources)
  - Fewer travelers (limited port fees)
  - Learning Curve with new systems
- **Personal**
  - Long delays due to learning curve and bugs
  - Lack of trust in new or existing technologies

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2. Candidate Technologies  
   5%

6
Technology Requirements

- Flexibility (Stand alone and integrated system)
- 450 bags/hour capacity (FAA req.)
- Low False Alarm Rate (5% FAA req.)
- Cost Effectiveness (Low Cost)
- Manufacturer Availability (2002 by Dec. 31- FAA req.)

Airline Security Candidate Technologies

- X-Ray - Computerized Axial Tomography
  - InVision Technologies, Inc. CTX-5000 SP, CTX-9000 CTS.
  - $350,000 - $1,000,000.
  - Obtain a number of cross-sectional images of a bag. Automatically alarms.
  - 75% Have been deployed in 1999.
  - Available in both standalone and integrated.
  - 364-364 depending.
  - 10% False alarm rate.
  - 120 days.

Airline Security Candidate Technologies

- Electromagnetic - Quadrupole Resonance
  - Quantum Magnetics Q-Scan 1000, QR 160, QR 500.
  - $350,000.
  - Currently available and in R&D for new products.
  - Available in both standalone and integrated.
  - 300-400 bags/hour.
  - 3% False Alarm Rate.
  - Available upon request.

Airline Security Requirements Matrix

<table>
<thead>
<tr>
<th>Candidate</th>
<th>Requirement</th>
<th>Flexibility</th>
<th>450 bags/ hr</th>
<th>False Alarm Rate</th>
<th>Cost</th>
<th>Availability</th>
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<tbody>
<tr>
<td>X-Ray</td>
<td>Yes</td>
<td>Yes</td>
<td>18%</td>
<td>$50K - $1M</td>
<td>120 days</td>
<td></td>
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<tr>
<td>Advanced</td>
<td>Yes</td>
<td>Yes</td>
<td>35%</td>
<td>$50K - $75K</td>
<td>In Stock - 120 days</td>
<td></td>
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<tr>
<td>X-Ray</td>
<td>Yes</td>
<td>No</td>
<td>No field</td>
<td>$75K - $100K</td>
<td>16-20 months</td>
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<tr>
<td>Electromagnetic</td>
<td>Yes</td>
<td>No</td>
<td>3%</td>
<td>$350K</td>
<td>Upon request</td>
<td></td>
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3. OTA Report Review 15%

Agenda

- Report Key Messages
- Assessment Methods Used
- Report Critique
  - Accuracy
  - Clarity & Flow
  - Linkage to Class
- Lessons Learned

4. Final Tech Selection Presentation 10%
Summary of Individual Technologies
- Global Positioning Systems (GPS)
- Mechanical Seals:
  - Barrier
  - Indicative
- RFID based Electronic Seals:
  - “Recording” - passive
  - “Alerting” - active
- Smart Containers
- CBID – removed from consideration

Technology Options
- Mechanical–Indicative
- Mechanical–Barrier
- Electronic/RFID–Recording
- Smart Containers
- GPS + Electronic/RFID–Alerting
- Mechanical–Barrier + Mechanical–Indicative

Criteria Selection (WHY?)
- Need For Acceptance
  - Promote Public Confidence
- Economic Feasibility
  - Avoid from Excessive Costs
- Effectiveness
  - Improve Cargo Security
  - Reduce Threat
- Feasible to Implement
  - Minimal Acceptable Standard

Criteria Selection (How?)
- SECURITY
  - Secure
  - Hard to Defeat
  - Accurate
  - Reliable
- COST
  - Durability
  - Unit Cost
  - Operating Cost
  - Maintainability
  - Equipment Cost
- DIFFUSION
  - Availability
  - Standards
  - Compatibility
- PERCEPTION
  - Political Perception
  - Public Perception

HDM (Hierarchy Decision Model)
- O1: Objective
- C1, C2, C3, C4: Criteria 1-4
- T1-T6: Technological options 1-6

Conclusion
- Deploying the assessment technology (GPS + Electronic/RFID–Alerting) can increase the security of containers against terror attacks and generate productivity benefits for the economy and profits for shippers, carriers, reduced theft and insurance costs.
- As they mature, improvements on these technologies will deliver greater efficiency, more effective customer service, and better security against theft and terrorism.

5. Final Report 15%
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ARTICLE LIST

Technology Assessment


Evaluation Methods

Technology Adoption and Diffusion


Applications in the Health Care Services Sector


Applications in the Energy Sector


Technology Foresight and Forecasting


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<th>Week/Day</th>
<th>Subjects to be Covered</th>
<th>Assignment Due</th>
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| Oct. 1   | • Introduction/Teams Formed  
          • **Lecture:** “Definitions of Technology” | • List of Team Members |
| Oct. 8   | • **Project Introductions at PSUBA**  
          • **Lecture:** “Technology Assessment Framework”  
          • Class Discussion: Team Project Topics  
          • Article Presentations | • Articles 1-8 |
| Oct. 15  | **Guest lecture:** Trace Thornberry – Technology Training  
          • Case 1: ToyWorld, Inc (Case study reports are due this day) | |
| Oct. 22  | • **Lecture:** “Technology Evaluation Methods”  
          • Article Presentations  
          • Case 2: General Electric Medical Systems | • Case Study Reports  
          • Linstone Chps 1-6  
          • Articles 9-20 |
| Oct. 29  | • **Lecture:** “Technology Acquisition”  
          • **Team Presentations:** “Gap Analyses”  
          • Cases 3 and 4: Intel Capital, Intel Research | • Gap Analysis Presentations  
          • Case Study Reports  
          • Rogers Chps 1-2 |
| Nov. 5   | • **Lecture:** “Technology Transfer, Adoption and Diffusion”  
          • Article Presentations  
          • Cases 5 and 6: IBM On Demand, IBM Tech Group | • Case Study Reports  
          • Rogers Chps 3-6  
          • Articles 21-29 |
| Nov. 12  | • **Lecture:** “Technology Assessment in Different Sectors”  
          • Article Presentations  
          • **Team Presentations:** “Candidate Technologies” | • Candidate Tech. Presentations  
          • Rogers Chps 7-11  
          • Articles 30-35 |
| Nov. 19  | • **Lecture:** “Technology Foresight and Forecasting”  
          • **Team Presentations:** “OTA Report Presentations”  
          • Article Presentations  
          • Case 7: Samsung Electronics | • OTA Report Presentations  
          • Case Study Reports  
          • Linstone Chps 7-9  
          • Articles 36-43 |
| Nov. 26  | **Guest lectures** | |
| Dec. 3   | • **Team Presentations:** “Technology Evaluation/Selection” | • Final Presentations  
          • Final report |