CPET 575 Management Of Technology

Part One
Integrating Technology and Strategy:
A General Management Perspective

- Technological Innovation
- Technological Innovation & Strategy

Lecture note based on the recommended text book:

Paul I-Hai Lin, Professor
http://www.ipfw.edu/~lin
M.S. Technology - IT and Advanced Computer Applications
Purdue University Fort Wayne Campus

Integrating Technology and Strategy:
A General Management Perspective

- Overview
- Key Concepts and Their Relationship
- Integrating Technology and Strategy
- Assessing Innovative Capabilities
- Conclusion

Overview

- Importance of Technology and Innovation
- Budget and spending on technology and innovation – related activities
  - High-tech company
  - Tech-oriented company
  - Start-up company
  - Who is responsible for strategic management of technology & innovation of a company, organization, firm, etc?
- Responsibilities
  - Acquire, develop, resource allocations
  - Develop and exploit the firm’s capability for innovation
Integrating Technology and Strategy: A General Management Perspective

- Key Concepts and Their Relationships
  - Inventions/Discoveries/Technologies
  - Technological Innovations
  - Technological Entrepreneurship
  - Activities and Outcomes
  - Interrelations Among Key Concepts

Integrating Technology and Strategy: A General Management Perspective

- Integrating Technology and Strategy
  - Perspective on Strategy
    - Positive Versus Normative Views
    - Product-Market Versus Resource-Based Views
  - Connecting Technology and Strategy
    - Technology & Competitive Strategy
    - Technology and Product-Market Strategy
    - Technology Portfolio
    - Technology Portfolio and Business Portfolio
  - Technology and the Value Chain
  - Technological Evolution and Forecasting
    - Technology Forecasting

Integrating Technology and Strategy: A General Management Perspective

- Assessing Innovative Capabilities
  - Innovative Capabilities Audit Framework
    - Innovative Capabilities
    - Business Unit Level Audit
    - Corporate Level Audit
    - Audit Frames of Reference
    - Who Should Do the Audit?

- Conclusion
Key Concepts and Their Relationships

- Inventions/Discoveries/Technologies
- Technological Innovations
- Technological Entrepreneurship
- Activities and Outcomes
- Interrelations Among Key Concepts

---

Key Concepts and Their Relationships

- Inventions/Discoveries/Technologies
  - Inventions/Discoveries
    - Results of creative process
  - How to measure the success
    - Technical (Is it true/real?) rather than Commercial (Does it provide a basis for economic returns?)
    - Patents – allow their inventors/originators to establish a potential for success
    - Successful innovations (subsequent refinement may be needed, with significant time lag, 10 years or more)

---

Key Concepts and Their Relationships (cont.)

- Inventions/Discoveries/Technologies
  - Technology
    - Refers to the theoretical and practical knowledge, skills, and artifacts that
      - Can be used to develop products and services as well as their production and delivery systems
      - Can be embodies in people, materials, cognitive and physical processes, plant, equipment, and tools
  - Outcome of development activities that put inventions and discoveries for practical use and applications
  - How to measure the success
    - Technical (Can it do the job?) rather than commercial (Can it do the job profitably?)
Key Concepts and Their Relationships (cont.)

- Inventions/Discoveries/Technologies
  - Technology – Success examples
    - The inventions of
      - Transistor (1947) at AT&T Bell Labs
      - Integrated Circuit (1959), and
      - Microprocessor (1971), Intel
    - Successive generations of new technologies in the semiconductor industry
      - Memory devices
      - Microprocessor, microcontrollers
      - Peripherals
    - Applications: business, industrial, manufacturing telecommunications, etc

Key Concepts and Their Relationships (cont.)

- Invention of Microprocessor
  - 1969
  - Nippon Calculating Machine Corporation, visited Intel to discuss its idea for custom Large-scale Integrated (LSI) circuits; and asked for designing 12 custom chips for its new Busicom 141-PF printing calculator
  - Ted Hoff, heading Intel’s application efforts, realized there was no practical way to implement the devices, and was sure a small general-purpose computer could do the job
  - Engineers Marcian E. “Ted” Hoff, Deferico Faggin, and Stan Mazor came up with a design that involved a set of four chips called MCS-4: 4004 CPU, ROM, RAM, and I/O

Key Concepts and Their Relationships (cont.)

- Invention of Microprocessor
  - Busicom eventually sold some 100,000 calculators
Key Concepts and Their Relationships (cont.)

  - 1972: 8008 Microprocessor
  - 1974: 8080 Microprocessor, (8085)
  - 1978: 8086-8088 Microprocessor
  - 1982: 286 Microprocessor
  - 1985: Intel386™ Microprocessor
  - 1989: Intel486™ DX CPU Microprocessor
  - 1993: Intel® Pentium® Processor
  - 1995: Intel® Pentium® Processor
  - 1997: Intel® Pentium® II Processor
  - 1998: Intel® Pentium II Xeon Processor
  - 1999: Intel® Celeron® Processor
  - • 2003: Intel® Pentium® M Processor ...

Key Concepts and Their Relationships (cont.)

- Technological Innovations
  - Technology-based Innovations
    - Examples: disposable diapers, oversized tennis racquets, electronic fuel injection, personal computers
  - Technology-facilitated Innovations
    - Examples: Business data processing & automation, ERP (Enterprise Resource Planning), CRM (Customer Relationship Management), SCM (Supply Chain Management), etc

Key Concepts and Their Relationships (cont.)

- Technological Innovations (cont.)
  - Outcomes
    - New and marketable products and services and/or new production and delivery systems
  - Levels of Significance
    - Incremental innovations
    - Radical innovations
    - Architectural innovations
Key Concepts and Their Relationships (cont.)

Technological Entrepreneurship
- Individual or corporate entrepreneurship
- Fundamental drivers of the technological innovation process
- Activities
  - Create new resource combinations to make innovation possible
  - Bring together the technical and commercial worlds in a profitable way
- Administrative capabilities: efficient, effective

Key Concepts and Their Relationships (cont.)

Activities and Outcomes
- Activities
  - Tinkering & Experimenting, and Systematic Basic and Applied R&D
- Outcomes
  - Inventions, Discoveries, and Technologies
  - Innovation Activities
  - Product, Process and Market Development
  - Innovation Outcomes:
    - Technological Innovations
    - Technological Innovation Activities (iterative & concurrent)
      - Product, Process, Market Development
      - Development of Administrative Capabilities
Integrating Technology and Strategy: Perspective on Strategy

- Positive vs. Normative Views
  - Positive View of Strategy:
    - Concerned with the firm’s actual strategy and how it comes to be
    - Resulted from organizational learning process
    - Top management belief’s about the basis of firm’s past and current success
      a) Core competencies
      b) Product market areas
      c) Core values, and
      d) Objectives, etc
  - Normative View of Strategy
    - Concerned with what the firm’s strategy should be

Integrating Technology and Strategy: Perspective on Strategy (cont.)

- Product-Market vs. Resource-Based Views
  - Product-Market View of Strategy
    - Concerned with how the firm competes with its products and services
  - Resource-Based View of Strategy
    - Concerned with how the firm can secure the factors needed to create core competencies and capabilities that form the basis for establishing and sustaining competitive advantages
    - Asks: “How do competencies and capabilities help create and sustain competitive advantages?”
  - Current Trend: Integrating Product-Market & Resource-based views

Integrating Technology and Strategy: Connecting Technology & Strategy (cont.)

- Technology and Competitive Strategy
- Porter’s “generic strategies”, 1985, – a framework for classifying competitive strategies: Technology Strategy
  a) Industry-wide differentiation (broad range of industry segments)
  b) Focused differentiation (a narrow set of industry segments)
  c) Industry-wide cost leadership
  d) Focused cost leadership (a narrow set of industry segments)
Integrating Technology and Strategy: Connecting Technology & Strategy (cont.)

Technology and Competitive Strategy

- Product-Related Technology
  - May be the basis for lower cost
  - Example: designing different models of cars, sharing common structural components (e.g., chassis), to lower the cost of the different models
- Process-Related (manufacturing) Technology
  - May be the key to product performance and hence differentiation
  - Manufacturing excellence example: early 1980s, it allowed Japanese DRAM manufacturers to differentiate their products from U.S. based competitors

Exhibit 2 Technological Policies and Generic Competitive Strategies

<table>
<thead>
<tr>
<th>Generic strategy</th>
<th>Overall cost leadership</th>
<th>Overall differentiation</th>
<th>Focus-seg. cost leadership</th>
<th>Focus-seg. differentation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technological Policies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product Tech. Change</td>
<td>Product dev. to reduce prod. cost by lowering materials content</td>
<td>Product dev. to enhance quality, features, or switching costs</td>
<td>Product dev. to design only enough performance for the segment's needs</td>
<td>Product dev. to meet exactly the needs of the particular business seg. application</td>
</tr>
<tr>
<td>Process Tech. Change</td>
<td>Learning curve process improvement</td>
<td>Process dev. to support high tolerance</td>
<td>Process dev. to tune production and delivery system to seg. needs in order to lower cost</td>
<td>Process dev. to tune the production &amp; delivery system to seg. need in order to improve performance</td>
</tr>
<tr>
<td></td>
<td>Facilitating ease manufacturing</td>
<td>Simplifying logistical req.</td>
<td>Faster response time to orders</td>
<td>Others</td>
</tr>
</tbody>
</table>

Integrating Technology and Strategy: Connecting Technology & Strategy (cont.)

- Technology and Product-Market Strategy
  - Expressed in the products and services it brings to market
  - Analyze the degree of integration
    - Decompose each product and service into its constituting technologies
    - Assess the relative strength – the degree of distinctive competence – the firm has with respect to that technology
  - Example: a firm manufacturing & marketing cameras
    - Competence in optic
    - Sufficient info is needed to determine firm's capabilities
    - Need to specifying how the strength can help – higher quality or lower cost?
April 14, 2009 25

Exhibit 3 The Product/Technology Matrix

<table>
<thead>
<tr>
<th>Technology 1</th>
<th>Product A</th>
<th>Product B</th>
<th>...</th>
<th>Product N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology 2</td>
<td>(*)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Each entry (*) should establish the firm’s relative strength vis-à-vis the state of the art.
Source: Adapted from A. Fusfeld, “How to Put Technology into Corporate Planning,” Technology Review, May 1978

April 14, 2009 26

Integrating Technology and Strategy: Connecting Technology & Strategy (cont.)

Technology Portfolio
- Technology Life Cycle
- Technology Importance
  - Value it brings to a particular class of products
  - Value it could potentially bring to other classes for the customer/user
- Relative Technology Position (reference to competitors)
  - Patent position, know-how and trade secrets, learning curve effects, and key talent
  - Strongly affected by the firm’s historical and future levels of investment

April 14, 2009 27

Exhibit 4 Developing the Technology Portfolio

<table>
<thead>
<tr>
<th>Technology Importance</th>
<th>Relative Technology Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Draw</td>
<td>Bet</td>
</tr>
<tr>
<td>Cash in</td>
<td>Low</td>
</tr>
<tr>
<td>Fold</td>
<td>Low</td>
</tr>
</tbody>
</table>

Exhibit 4 Developing the Technology Portfolio (cont.)

- Bet quadrant (Rel. Tech. Pos. – High, Tech. Imp. – High)
  - Warrant the full commitment:
  - Frontier R&D, push the limits of its product development process, and invest in the newest equipment
- Cash in quadrant (RTP – High, TI – Low-Mid)
  - Examined carefully
  - Tech may have been important at one time, but it’s importance is reduced
  - Suggest that no further investment in these technologies

Integrating Technology and Strategy: Connecting Technology & Strategy (cont.)

- Technology Portfolio and Business Portfolio
  - Companies
    - Has multiple businesses in their corporate portfolios, each with its own technologies
  - Portfolio planning tool - McKinsey’s framework based on industry attractiveness and competitive position dimensions
  - Harris, Shaw, and Somers suggest examining the relationship between
    - Traditional portfolio planning matrix
    - Technology portfolio matrix
Integrating Technology and Strategy:
Technology and the Value Chain

- Broader sense of technology
  - Encompasses the entire set of technologies employed in the sequence of activities that constitute a firm’s value chain
- Activities
  - R&D, designing, manufacturing, marketing, delivering, and supporting its product
- Value
  - The amount buyers are willing to pay for what a firm provides them
  - Measured by total revenue, a reflection of the price a firm’s product commands and the units it can sell
- Value chain (total value, value activities)
  - Supplier’s value chain
  - Channel’s value chain
  - Buyer’s value chain …

---

Exhibit 6 Representative Technologies in a Firm’s Value Chain

<table>
<thead>
<tr>
<th>Internal Logistics</th>
<th>Operations</th>
<th>Outbound Logistics</th>
<th>Marketing Skills</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information system technology</td>
<td>Transportation technology</td>
<td>Material handling technology</td>
<td>Machine tool technology</td>
<td>Material technology</td>
</tr>
<tr>
<td>Resin and plastic technology</td>
<td>Material handling technology</td>
<td>Packaging technology</td>
<td>Information system technology</td>
<td>Communication system technology</td>
</tr>
<tr>
<td>Packaging technology</td>
<td>Machine tool technology</td>
<td>Machine tool technology</td>
<td>Information system technology</td>
<td>Information system technology</td>
</tr>
<tr>
<td>Machine tool technology</td>
<td>Machine tool technology</td>
<td>Machine tool technology</td>
<td>Information system technology</td>
<td>Information system technology</td>
</tr>
<tr>
<td>Machine tool technology</td>
<td>Machine tool technology</td>
<td>Machine tool technology</td>
<td>Information system technology</td>
<td>Information system technology</td>
</tr>
<tr>
<td>Machine tool technology</td>
<td>Machine tool technology</td>
<td>Machine tool technology</td>
<td>Information system technology</td>
<td>Information system technology</td>
</tr>
<tr>
<td>Machine tool technology</td>
<td>Machine tool technology</td>
<td>Machine tool technology</td>
<td>Information system technology</td>
<td>Information system technology</td>
</tr>
<tr>
<td>Machine tool technology</td>
<td>Machine tool technology</td>
<td>Machine tool technology</td>
<td>Information system technology</td>
<td>Information system technology</td>
</tr>
<tr>
<td>Machine tool technology</td>
<td>Machine tool technology</td>
<td>Machine tool technology</td>
<td>Information system technology</td>
<td>Information system technology</td>
</tr>
<tr>
<td>Machine tool technology</td>
<td>Machine tool technology</td>
<td>Machine tool technology</td>
<td>Information system technology</td>
<td>Information system technology</td>
</tr>
</tbody>
</table>

Integrating Technology and Strategy:
Technology Evolution and Forecasting

- Technology Product Life Cycle
  - Technology change affecting firm’s competitive position
  - Firm find it difficult to respond to such changes
  - Integrating technology & strategy
    - Understand life cycle of various technologies it employs
    - Potential for competitive advantage

Exhibit 7 Technology Life Cycle and Competitive Advantages

<table>
<thead>
<tr>
<th>Stages in Technology Life Cycle</th>
<th>Importance of Technologies for Competitive Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Emerging technologies</td>
<td>Have not yet demonstrated potential for changing the basis of competition.</td>
</tr>
<tr>
<td>II. Packing technologies</td>
<td>Have demonstrated their potential for changing the basis of competition.</td>
</tr>
<tr>
<td>III. Key technologies</td>
<td>Are embedded in and enable product/process.</td>
</tr>
<tr>
<td>IV. Base technologies</td>
<td>Have major impact on value-added stream (cost, performance, quality).</td>
</tr>
<tr>
<td></td>
<td>Allow proprietary/patented positions</td>
</tr>
<tr>
<td></td>
<td>Have minor impact on value-added stream; common to all competitors; commodity</td>
</tr>
</tbody>
</table>

Assessing Innovative Capabilities

- Persons – who responsible for managing the innovation process
- Firm’s innovative potential and into the barriers to innovation
- Decisions on Innovations: managerial attention, resources
- Innovation capabilities audit (address at least 3 questions)
Assessing Innovative Capabilities

- Innovation capabilities audit (address at least 3 questions)
  - Firm’s innovative areas: product and service offering and/or production and delivery systems?
  - The fit?
    - Between the firm’s current business and corporate strategies and its innovative capabilities
  - Innovative capabilities needed?
    - To support its long-term business and corporate competitive strategies?

Assessing Innovative Capabilities: Innovative Capabilities Audit Framework

- Innovation depends on
  - Technological Capabilities, and other critical capabilities in the areas
    - Manufacturing
    - Marketing and distribution
    - Human resource management
  - An example:
    - Technology strategy – achieve superior product performance, must be complemented by
      - A technically trained sales force that can educate the customer regarding the product’s performance advantages, and
      - A high-quality manufacturing system
    - A 1978 case: 16-bit microprocessors
      - Intel 8086/Motorola 68000/Zilog Z800

Assessing Innovative Capabilities: Innovative Capabilities Audit Framework

- Innovation Capabilities
  - The comprehensive set of characteristics of an organization that facilitate and support innovation strategies
- Audit at both levels
  - Business unit
    - A particular strategy and resource commitment
    - A distinct set of product markets, competitors, and resources
  - Corporate (multi-business)
    - Overall corporate innovation strategy
Assessing Innovative Capabilities: Innovative Capabilities Audit Framework

- **Business Unit Level Audit**
  - Focus on
    - New products and services, and/or
    - New production and delivery systems
  - Can be characterized in terms of
    - Timing of market entry
    - Technological leadership or followership
    - Scope of innovativeness, and
    - Rate of innovativeness

---

**Exhibit B Innovative Capabilities Audit Framework—Business Unit Level**

---

**Business Unit Level: Innovative Capabilities Audit Framework**

- Five important categories of variables influence the innovation strategies of a business:
  - Important for formulation
    1. Resources available for innovative activities
    2. Capacity to understand competitors’ strategies and industry evolution with respect to innovation
    3. Capacity to understand technological developments relevant to the business unit
  - Important for implementation
    4. Structural and cultural context of the business unit affecting internal entrepreneurial behavior
    5. Strategic management capacity to deal with internal entrepreneurial initiatives
Assessing Innovative Capabilities: Innovative Capabilities Audit Framework (cont.)

- Audit Frames of Reference
  1. Interpreting the results of the innovative capabilities audit
     - How the current situation compares to the past
  2. Firm’s position relative to current competitors
     - Identify - positions desired

Assessing Innovative Capabilities: Innovative Capabilities Audit Framework (cont.)

- Who Should Do the Audit?
  - Vice-president (General Manager, Senior Manager)
  - Insiders - advantages/disadvantages
  - Outsiders - advantages/disadvantages
  - Undertaken by
    - Firm’s strategic planning department
    - Ad Hoc Audit team (task force)
      - Strategic planning
      - R&D
      - New product managers
      - Key functional managers
Conclusion

- Key Concepts and Their Relationship
  - Technology
  - Innovative Strategies
- Integrating Technology and Strategy
- Assessing Innovative Capabilities