15.912 Technology Strategy
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Creating Value with Effective Organization

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MIT Sloan School of Management
Creating Value:

• Understand how technologies will evolve  
  – (Both your own and those on which you rely)

• Understand how customer needs will evolve

• **Use technologies** to develop world class products and services that **meet customer needs**
  – How?
    • Get lucky…works once or twice
    • Do it consistently with effective Organization Structures and Processes
      – e.g., Apple, Google
Effective Organization changes during discontinuities

How do we manage incremental innovation?

How do we manage discontinuous innovation?

Performance

Time
Illustrating the problem: to centralize or decentralize R&D?

• Answering this question involves two major problems:
  • The role of CR&D
  • Commercializing the technology

• These two issues cannot be addressed in isolation
Research before the World Wars

Goal: Understand the world
Incentive: prestige, fun, the social good
First “gentlemen” & then Universities, Foundations

Firms
Goal: Make the widget work
Incentive: Make $$
Research before the World Wars

“Basic”, “Curiosity driven” research

• Researchers motivated by the intrinsic interest of the problem, orientated to their peers, not to application
• Choice of problems dictated by individual researchers on the basis of curiosity

“Applied” research

• Researchers motivated by the desire to make money, have an impact on the world
• Choice or problems motivated by the needs of the market place
Research before the World Wars

• “Basic” research makes enormous progress, but few firms invest in it.
  – Except the German chemical industry
• Many major technological advances driven by engineers “tinkering”
  – Steel, Steam
• And technological advances that do use science use old, publicly available science
  – Electricity
  – Telephony
Sputnik and the World Wars

Goal: Understand the world
Goal: Make the widget work
Incentive: Make $$

Radar
The Atom Bomb
Penicillin
The Man on the Moon

Universities, Foundations

First gentlemen & then
After the Wars

Goal: Understand the world

Goal: Make the widget work

Incentive: prestige, fun, the social good

Incentive: Make $$

Universities, Foundations

Office of Naval Research

NIH

Central Research Labs

NASA

DOD

Traditional Applied Research
Corporate Research Labs in the Golden Age

- Bell Labs
- RCA Sarnoff Labs
- Xerox Parc
- IBM & the Watson Labs
- GE
- Alcoa
- DuPont
The Golden Age Research Model: “Build it and they will come”

- Do the very best science
- Make major breakthroughs
- Take them to the market And get really rich

For Example:
- The transistor
- The CAT scanner
- Cohen/Boyer patent
- Nylon
- Protease Inhibitors
Core assumptions of “golden age” research

• Curiosity driven – understand the problems and the applications will follow
• Not overly constrained by financial or cost goals
• Hire the very best people and give them freedom
• Stay closely connected to the university and to the community of public science
More recently:
The Golden Age model in question

- Many firms unable to capitalize on major discoveries, or benefits take years to emerge:
  - The RCA disc
  - Xerox PARC
  - Kevlar
  - Lucent & Bell Labs

- A significant number of breakthroughs come through close user/market contact (i.e., Open Innovation)...

- ...and technology collaborations between firms (i.e., Collaborative Innovation).
  - Intel/MSFT, HP/Cisco, Apple/Google, etc.
Some firms continue to fund central research aggressively.

“Basic” or “fundamental” science

Genomics, Photonics
Msoft, P&G

“Applied” research
But others have moved away from central research completely.
Or experiment with alternative organizational forms
Other firms have experimented with hybrid organizational structures

<table>
<thead>
<tr>
<th>Centers of Excellence</th>
<th>Teams</th>
<th>Matrix</th>
</tr>
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<tbody>
<tr>
<td><strong>Pros</strong></td>
<td></td>
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<tr>
<td>- Supports necessary scale for critical technologies</td>
<td>- Focused cross functional coordination</td>
<td>- Focused attention to multiple objectives</td>
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<tr>
<td>- Manage career paths</td>
<td>- More efficient development</td>
<td>- Best of both worlds: coordination and specialization</td>
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<tr>
<td>- Avoid redundancy</td>
<td>- Development of team and management skills</td>
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<table>
<thead>
<tr>
<th>Cons</th>
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<tbody>
<tr>
<td>- Difficult inter-unit communication</td>
<td>- Confusion of team roles</td>
<td>- Confusion of roles</td>
</tr>
<tr>
<td>- Restricted view of whole</td>
<td>- Shortage of good project management</td>
<td>- High overhead</td>
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<tr>
<td>- Can become too removed from the business</td>
<td>- Death by many teams</td>
<td>- Powerful individuals tip the balance of power</td>
</tr>
<tr>
<td></td>
<td>- Degradation of fxnl skills</td>
<td>- Worst of both worlds</td>
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Strategic Challenge: Changing Environments are Unpredictable and Ambiguous!

**SOURCES**

- Future S-curves and market evolution are hard to predict!
- Blurred timing and paths
- Shifting competitive basis, from products to business models
- Lack of control over key technology resources

**IMPLICATIONS**

- Planning is limited
- Reacting is insufficient
- Traditional strategies of “defend a position” and “leverage core competence” are incomplete
- Shift from “closed” internal innovation to “open” innovation with partners
Potential Solution: Organizational Structures that respond to change

Hierarchy

Unit Networks

Roles

Rules

Alliance Networks

Organizational Structures enable coordinated responses to environmental change by shaping action in real-time.
Amount of Organizational Structure can vary greatly!

Hierarchy

Low

Medium

High

Rules

Unit Networks

Alliance Networks
Inverted U-shaped Relationship btwn the Amount of Structure and Performance

- Fundamental Relationship illustrates the tension between efficiency and flexibility
- Observed in multiple industries and for multiple types of structure:
  - Hierarchy
  - Roles
  - Rules
  - Networks
New Modeling and Evidence suggests Asymmetry and Dependency on Market Dynamism

- **Asymmetry**: more forgiving on the side of too much structure
- **Optimum is less structured and more severe** in less predictable environments
### Examples: Simple Rules in Dynamic Markets

<table>
<thead>
<tr>
<th>Company</th>
<th>Simple rules</th>
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</table>
| **Intel®**       | • Priority Rules helped Intel shift from DRAMs to Intel® Microprocessors  
                   • Simple Rules about minimum project size  
                   • Copy Exactly |
| **Pfizer®**      | • Clear ranking molecules types as research priorities  
                   • Maximum number of molecule types pursued at any one time  
                   • Projects “killed” according to step charts |
| **Miramax Films®** | • Movies must  
                   – Center on a basic human condition and flawed, but sympathetic character  
                   – Have a clear beginning, middle, and end  
                   • Disciplined financing (50% more efficient than industry standard) |

*The Crying Game, Pulp Fiction, The English Patient, Life is Beautiful, Shakespeare in Love*
Explains mysterious organizational phenomena:

- **Liability of newness**: less structured entrepreneurial firms can “collapse from within” while large firms with more structure can “muddle through” with little innovation.

- **Maintaining optimal structure**: is more precarious (more V-like than U-like!) in unpredictable markets:
  - Emerging markets
  - High-technology industries

- **Effective strategy**: is more simple in highly dynamic markets
  - Less structure enables more flexible responses
Key Lessons about Organization Structure

• Managers need to manage not only the Content but the Amount Structure

• Employees can (and sometimes should) subvert structures!

• Structure is merely a constraint on actions... must be combined with improvisation and creativity to produce innovations.

• Organizational Processes that change over time are as strategically important as Organizational Structures that do not...
...All R&D structures have limitations that can (in principle) be managed with the right processes

Making Central Research more Decentralized

- Institute “contracting” mechanism whereby Business Units can invest their R&D dollars by sponsoring projects in central Research
- Create Councils comprising senior technical members (e.g. TDOs) from the business units to win endorsement for Research programs and ensure relevance
- Provide communication mechanisms for central Research to showcase their programs (conferences, “technology fairs”, “catalogs”, “trolling”)
- Institute funding mechanisms that require project transfer to the business at a future date or require projects to win matching funds from the business
- Support internship programs that lend researchers to the businesses
- Organize by product technology

Making Decentralized Research more Central

- Employ Portfolio process that ensures balance between platforms, derivatives, and breakthroughs
- Create cross-Business Councils responsible for synergies between research done within the businesses
- Fund outside research in universities, start-up companies, or other outside organizations
- Co-locate Decentralized R&D resources within central labs to promote synergy and preserve critical mass in scientific disciplines
Comparing Org Structures & Org Processes

• **Organizational Structures**: repeatable patterns of behavior that are (nearly) always invariant
  – Act as a constraint on action; enable efficient coordination between multiple employees
  – Must be combined with real-time improvisation and creativity to execute new opportunities

• **Organizational Processes**: sequenced patterns of behavior that change & are contingent on time/place
  – Strategic impact of effective versus ineffective processes less well explored...
  – These “best practices” or “secret sauce” are so hard to imitate (e.g., Apple’s design process), that they may provide more competitive advantage than structural solutions that all can copy (e.g., Matrix org charts)
**Patching: Restitching Business Portfolios**

<table>
<thead>
<tr>
<th>Common experiences</th>
<th>Myths</th>
<th>Best practice</th>
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<tbody>
<tr>
<td>• Coordinating across businesses to exploit opportunities is slow and political</td>
<td>• Critical issue is business focus (e.g., customer, products, geos)</td>
<td>• Regard match of business portfolio to markets as temporary</td>
</tr>
<tr>
<td>• Businesses are behind others in capturing opportunities</td>
<td>• Adjustment of business portfolio to match markets occurs in rare, major restructurings</td>
<td>• Pay attention to SCALE of businesses as well as focus</td>
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<tr>
<td></td>
<td></td>
<td>• Patching executive at multibusiness level</td>
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<tr>
<td></td>
<td></td>
<td>• Economies of scale AND agility</td>
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Patching: Restitching Business Portfolios

<table>
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<tr>
<th>Company</th>
<th>Managing scale and focus</th>
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<tbody>
<tr>
<td>Dell®</td>
<td>• Patches customer segments and products</td>
</tr>
<tr>
<td></td>
<td>• In 1994, 2 customer patches then 4 then 8 now about 18</td>
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<tr>
<td></td>
<td>• Decreased patch size with increasingly uncertain market</td>
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<tr>
<td>Hewlett Packard®</td>
<td>• Built printer businesses by frequently realigning divisions to market opportunities - add, exit, combine, split</td>
</tr>
<tr>
<td></td>
<td>• Shifts products and businesses among divisions as needed</td>
</tr>
<tr>
<td></td>
<td>• Prototypical patching results</td>
</tr>
<tr>
<td></td>
<td>– From instruments to computing, from computing to printing and desktop publishing, and to digital photography</td>
</tr>
<tr>
<td>Honda®</td>
<td>• Took market lead in Japan by repatching traditional recreational vehicle businesses (minivans, station wagon, compact sedans, SUV) into three new, original patches</td>
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</tbody>
</table>
Patching example – Honda’s domestic recreational vehicle (RV) business

**Traditional RV market patching**
- Minivans
- Station wagon
- Compact sedans
- Sport utility vehicle

**Honda refreshed patching**
- **Odyssey:** Shorter than a minivan but bigger than station wagon
- **Criteria:** Compact-cum-wagon with “Godzilla” styling
- **CR-V:** Similar to Jeep Cherokee but smaller and built on the Honda Civic platform
Patching example – Dell

1994
- Large customers
- Small customers

1996
- Large companies
- Midsize companies
- Government and education
- Small customers

1998
- Global enterprises
- Large companies
- Midsize companies
- Federal
- State and local
- Education
- Small companies
- Consumers
## Coevolving: Cross-business Synergy

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<tr>
<td>• Senior management wants cross-business synergies, but is unsuccessful</td>
<td>• Successful companies operate as a centrally controlled portfolio of related businesses</td>
<td>• A few temporary collaborations with exceptional payoffs</td>
</tr>
<tr>
<td>• Orchestrating collaboration across businesses is a time sink</td>
<td>• Successful companies operate as a portfolio of independent businesses</td>
<td>• Manage NUMBER of collaborations, not just focus</td>
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<tr>
<td></td>
<td></td>
<td>• Senior managers set context for collaboration, businesses decide</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Synergies AND individual business success</td>
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</table>
## Coevolving: Cross-business Synergy

<table>
<thead>
<tr>
<th>Company</th>
<th>A few collaborations</th>
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</table>
| **Disney** | • “Multiplier effect” of sharing movie characters across businesses  
| | • Selective collaboration (e.g., Disney characters not shared with Touchstone)  
| | • Senior executives set collaborative context (e.g., synergy meetings, calendar, synergy managers, training boot camp), but business managers make the choices |
| **Kroger** | • Broadcast identity of best practice stores for specific capabilities (transactive memory)  
| | • Store managers select best practices most appropriate for their stores (receiver-based communication) |
| **BP** | • “Key to earning a big return is to replicate knowledge” – John Browne, CEO  
| | • SBU's belong to 1 of 4 peer groups for knowledge exchange, facilitated by electronic yellow pages  
| | • Participation is voluntary and comes out of SBU budget |
Relationship Processes: Towards Open & Collaborative Innovation

- Closed Innovation
- Collaborative Innovation
- Open Innovation
Relationship Processes & Collaborative Innovation

• Technology Collaborations between large established firms are becoming the predominant way that innovative component technologies are made in IT:
  – Google & Apple: iPhone collaborations: gMaps, YouTube player
  – Intel & Microsoft: Wintel technologies
  – Sun & SAP: Netweaver Java Platform
• What are the most effective Organizational Processes for managing these relationships?
  – Focus on Strategic Decision Making, Social Networks, Time-Pacing
  – Examined 8 collaborations between 10 large firms in the IT sector
Domineering Leadership

- De-motivated weaker partners do minimum required by contracts
- Achieves stronger partner’s more routine objectives, but with…
- No innovation!
Consensus Leadership

- Unclear Roles and Responsibility
- Many meetings!
- Slow development
- “Lowest common denominator” decision making
- No Innovation
Rotating Leadership & Collaborative Innovation

• Highly motivated partners contribute best technologies and IP
• Breaks inward focus of central-planning by single firms
• Rotations encourages recombination of technologies over time, leading to...

• Generation of Multiple Innovations:
  • New components
  • New platforms
  • New patents
  • Revenue growth: up to $1B+

Image by MIT OpenCourseWare.
Domineering Leadership

- Actors play same roles over time…
- …fails to involve many valuable employees in dominated firm

Image by MIT OpenCourseWare.
Consensus Leadership

- Maximum involvement!
- Pair of project managers involves everyone in all aspects of work…
Rotating Leadership & Collaborative Innovation

- Leadership rotations generate Fluctuating Cascades of Social Network Activation over phases of Collaboration
- Varies team composition
- Different people work at different times…new perspectives + needed time for rest!

Image by MIT OpenCourseWare.
Looking Forward:

• Creating Value through Effective Organization:
  – Organization Structure:
    • Centralization is a key dimension of R&D structuring
    • But there are many types of structure
    • Amount of Structure as important as the type!
    • Simpler strategies in more dynamic markets
  – Organization Processes:
    • Patching
    • Co-evolving
    • Relationships and Collaborative Innovation:
      – Rotating Leadership and Fluctuating Networks

• Next session we move to Value Capture & Abgenix (biotech!)