University-Industry Partnerships in Japan

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Outline of Presentation

- University-Industry Partnerships in a National Innovation System

- University-Industry Partnerships
  - Historical Development in Japan
    - The First Engineering Department of a University in the World
      -- Department of Engineering, Tokyo University --
    - A Research Institute that Lead a Large Industrial Group
      -- RIKEN (Institute of Physical and Chemical Research) --
  - Recent Movements in Japan
    - Joint Research
    - Technology Licensing
    - Academic Spin-offs -- From “Collaboration” to “Cross-over” --

- Concluding Remarks
University-Industry Partnerships in a National Innovation System
Role Charts
(unit: %)

Universities

Japan (2003)
B A D
(14.5) (23.0) (62.4)
46.5 20.4 1.8

USA (2003)
B A D
(19.1) (23.9) (57.1)
62.0 16.1 2.0

Public Research Institutes

19.6

12.2 5.7

8.2 13.0 7.2

Industry

31.4

64.1 91.2

15.5 64.1 89.1
Question:
How can we utilize S&T for society, economy and business in a national innovation system?

Public Sector
Universities
Public Research Institutes
Accumulated S&T Knowledge
S&T Potential Personnel Facilities

Joint Knowledge Creation
Transfer
Starting up

Private Sector
People
Industry
Society
Economy
Business

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Science vs. Technology

Knowledge

Wealth

SCIENCE

Knowledge

Universities

Knowledge

Industry

Wealth

Utility

Knowledge

Wealth

TECHNOLOGY

Knowledge

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Science-Based Technology

Note. The author modified the diagram of Stokes (1997).
University-Industry Partnerships
Historical Development in Japan
The First Engineering Department of a University in the World

- Imperial College of Engineering was established under Ministry of Engineering in 1873.

- This became College of Engineering of Imperial University (Current Tokyo University) in 1886.
Education at Imperial College of Engineering

- Dr. Henry Dyer from Scotland was the President from 1873-1882.
- Combination of Theories and Practices
  - School 2 years
  - College 2 years
  - Practice 2 years
- Graduates worked in the industry.
- Japanese universities were application-oriented in the beginning.
A Research Institute that Lead a Large Industrial Group
- RIKEN (Institute of Physical and Chemical Research) -

- Academic Achievement
  - 2 Nobel Prize Laureates:
    - Dr. Yukawa and Dr. Tomonaga
    - (Dr. Fukui was also related.)
  - 1,686 papers in Japanese and 1,072 papers in foreign languages from 1922 to 1941

- Industrial Achievement
  - RIKEN registered 0.7 percent of all patents (848 patents) registered in Japan during the period from 1918 to 1944.
  - The RIKEN Industrial Group consisted of 63 companies at its peak. One of them is the root of Ricoh.
Establishment of RIKEN

Dr. Jokichi TAKAMINE, a scientist and millionaire living in the United States, pointed out the need for a National Science Research Institute in 1913.

Prime Minister Shigenobu OKUMA convened the Council to Promote Establishment of RIKEN in 1916.

It was established as a nonprofit foundation in 1917 and was abolished in 1948.

Some principal researchers were joint appointment of university professors.
## Revenue of RIKEN

<table>
<thead>
<tr>
<th>year</th>
<th>1927</th>
<th>1939</th>
<th>1940</th>
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<tbody>
<tr>
<td></td>
<td>thousand yen</td>
<td>%</td>
<td>thousand yen</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>13</td>
<td>2.0</td>
<td>264</td>
</tr>
<tr>
<td>patent royalty</td>
<td>0</td>
<td>0.0</td>
<td>1793</td>
</tr>
<tr>
<td>production work</td>
<td>206</td>
<td>31.2</td>
<td>53</td>
</tr>
<tr>
<td>stock operation</td>
<td>37</td>
<td>5.6</td>
<td>740</td>
</tr>
<tr>
<td>rent</td>
<td>6</td>
<td>0.9</td>
<td>1</td>
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<tr>
<td>interests and dividends</td>
<td>143</td>
<td>21.7</td>
<td>793</td>
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<tr>
<td>subsidies</td>
<td>250</td>
<td>37.9</td>
<td>0</td>
</tr>
<tr>
<td>miscellaneous</td>
<td>4</td>
<td>0.6</td>
<td>61</td>
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<tr>
<td>total</td>
<td>660</td>
<td>100.0</td>
<td>3705</td>
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</table>

Unique Management Concepts of RIKEN Industrial Group

- Science Capital Industry (Scientific knowledge is the key.),

- Intellectual Management (eg. mechanical engineering for chemical plants),

- Combinatory Management (the use of byproducts for other processes in the same premise) and

- Rural Industrialization with Single-Function Machines
University-Industry Partnerships
Recent Movements in Japan
Forms of University-Industry Partnership

- Joint Knowledge Creation
  - Joint research
  - Contract research
  - (Donation)
  - Comprehensive collaboration agreement

- Knowledge Transfer
  - Journal papers and books
  - Conference presentations
  - Via students
    - Graduating students
    - Internship in companies
    - Students sent by companies
  - Consultancy
  - Licensing

- Knowledge-based Starting Up
  - Academic spin-offs

  2. Facility and equipment usage is another form of partnership.
Policies to Promote University-Industry Partnerships in Japan

Joint Knowledge Creation
- Joint Research Centers
- Research Grants for University-Industry Collaborative Research

Knowledge Transfer
- Technology Licensing Organizations (TLOs)
- University IPR Management Centers

Knowledge-based Starting Up
- Venturing Business Laboratories (VBLs)
- Incubation Centers
- Relaxation of the regulation on side jobs

Overall
- Changing National Universities into National University Agencies
Joint Research Centers at National University

Number of center for joint research

Pre-First Plan Period → First Plan Period ← Second Plan Period

Cumulative total of centers

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<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Centers</td>
<td>3</td>
<td>8</td>
<td>13</td>
<td>18</td>
<td>23</td>
<td>28</td>
<td>33</td>
<td>38</td>
<td>43</td>
<td>47</td>
<td>49</td>
<td>52</td>
<td>53</td>
<td>56</td>
<td>61</td>
<td>62</td>
</tr>
<tr>
<td>(Number established annually)</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td></td>
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Source: MEXT Website
Offices for University-Industry Cooperation

Data: Based on the responses to “Questionnaire Survey on Achievements of S&T Basic Plan (survey on policies related to industry-academia-government cooperation and regional innovation),” (distributed in June 2004)

Source: NISTEP

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University – Industry Joint Research

Data: The data for national universities is calculated, using the source from MEXT HP and its “University-Industry Research Cooperation: A Status Report, 1983-2001,” March 2003. Others are based on the result from the questionnaires made by NISTEP and Mitsubishi Research Institute, Inc. (distributed in 2004).

Source: NISTEP
Trends of Joint Research at Yokohama National University
- Deepening and Diversification -

- Deepening
  - Number of joint research projects per company increased.
  - Joint research projects with large budget increased.
  - Joint research in the same prefecture increased in terms of number and total budget.

- Diversification
  - The budget difference between the largest and the smallest became wider.
  - Joint research projects with new companies including MNCs increased.
  - The ratio of university researchers conducting joint research with companies over all university researchers increased.

Coauthorship between Company Researchers and University Researchers

Source: (Japan)Prepared by NISTEP using the CD-ROM version of SCI

Source: NISREP REPORT No.74 (2004)
**Science Linkage in U.S. Patents**

**All Areas**

- **Japan**
- **U.S.**
- **EU**

*Science linkage* is the number of cited scientific papers in the U.S. patent examination reports per registered patent. It indicates a frequency of the use of scientific knowledge among patents.


**Source:** NISTEP

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# University Licensing (Japan-US Comparison)

<table>
<thead>
<tr>
<th></th>
<th>Japan</th>
<th>US</th>
<th>Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D</td>
<td>3.3 trillion yen (2002)</td>
<td>5.4 trillion yen (2002)</td>
<td>1.6</td>
</tr>
<tr>
<td>License Income</td>
<td>0.55 billion yen (2003)</td>
<td>145 billion yen (2002)</td>
<td>264</td>
</tr>
</tbody>
</table>

Source: NISTEP
Academic Spin-Offs
Stage-by-Stage Penetration

An Enterprise to Overseas Market

Exports → Licensing → FDI

A Professor (or a Researcher) to Market/Society

Consulting
Students
Joint Research

→ Licensing

→ Start-up

Academic Spin-Offs in Japan

Academic Spin-Offs

*Accumulated total is 916 as of August of 2004.

Academic Spin-Offs by Areas

*: Breakdown of 916 companies as of August 2004.

Data: Calculated by NISTEP based on “University-Spin-Off Survey FY2004” by Tsukuba University and Yokohama National University.

Source: NISTEP
Newspaper Articles on “University Spin-offs” in Japan

Note. The number of articles in four newspapers published by NIKKEI.
Cross-over among Industry, Universities and Public Research Institutes


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Profiles of Academic Spin-off Founders

Table: Profiles of Founders

<table>
<thead>
<tr>
<th>Founders</th>
<th>Ratios (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty</td>
<td>69.7</td>
</tr>
<tr>
<td>of which professors</td>
<td>44.2</td>
</tr>
<tr>
<td>Students</td>
<td>22.9</td>
</tr>
<tr>
<td>of which doctor course students</td>
<td>11.2</td>
</tr>
<tr>
<td>of which master course students</td>
<td>7.5</td>
</tr>
<tr>
<td>of which undergraduate students</td>
<td>3.0</td>
</tr>
<tr>
<td>Researchers/technicians</td>
<td>7.5</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: FY2004 Survey.
## Future Business of Academic Spin-offs

### Future Business

<table>
<thead>
<tr>
<th>Intended Future Business</th>
<th>Ratios (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Licensing out</td>
<td>25.7</td>
</tr>
<tr>
<td>Product sales using OEM</td>
<td>22.4</td>
</tr>
<tr>
<td>Product manufacturing and sales</td>
<td>16.1</td>
</tr>
<tr>
<td>Contract research and design</td>
<td>14.6</td>
</tr>
<tr>
<td>Sales of developed patents</td>
<td>11.5</td>
</tr>
<tr>
<td>Others</td>
<td>9.6</td>
</tr>
</tbody>
</table>

Source: Year 2004 Survey.
Concluding Remarks
Some Reservations

- A university needs to keep its identity.
- Rules to avoid conflicts of interests need to be established.
- Practices to handle research tool patents in academic research need to be established.
The Roles of University-Industry Partnerships in Japan

At the national level

- Narrowing the gap between high S&T potential and low industrial performance to strengthen industrial competitiveness

- Creating internationally competitive universities

At the regional level

- Creating regional innovation systems
  - University-industry collaborative R&D and university spin-offs are promoted in regional innovation policies.
    - Knowledge Cluster Initiative
    - Industrial Cluster Program