University-Industry Partnerships in Japan

Presented at
Symposium on "21st Century Innovation System for Japan and the United States"
Tokyo, January 10-11, 2006

Prof. Masayuki KONDO
Yokohama National University/
National Institute of Science and Technology Policy (NISTEP)

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

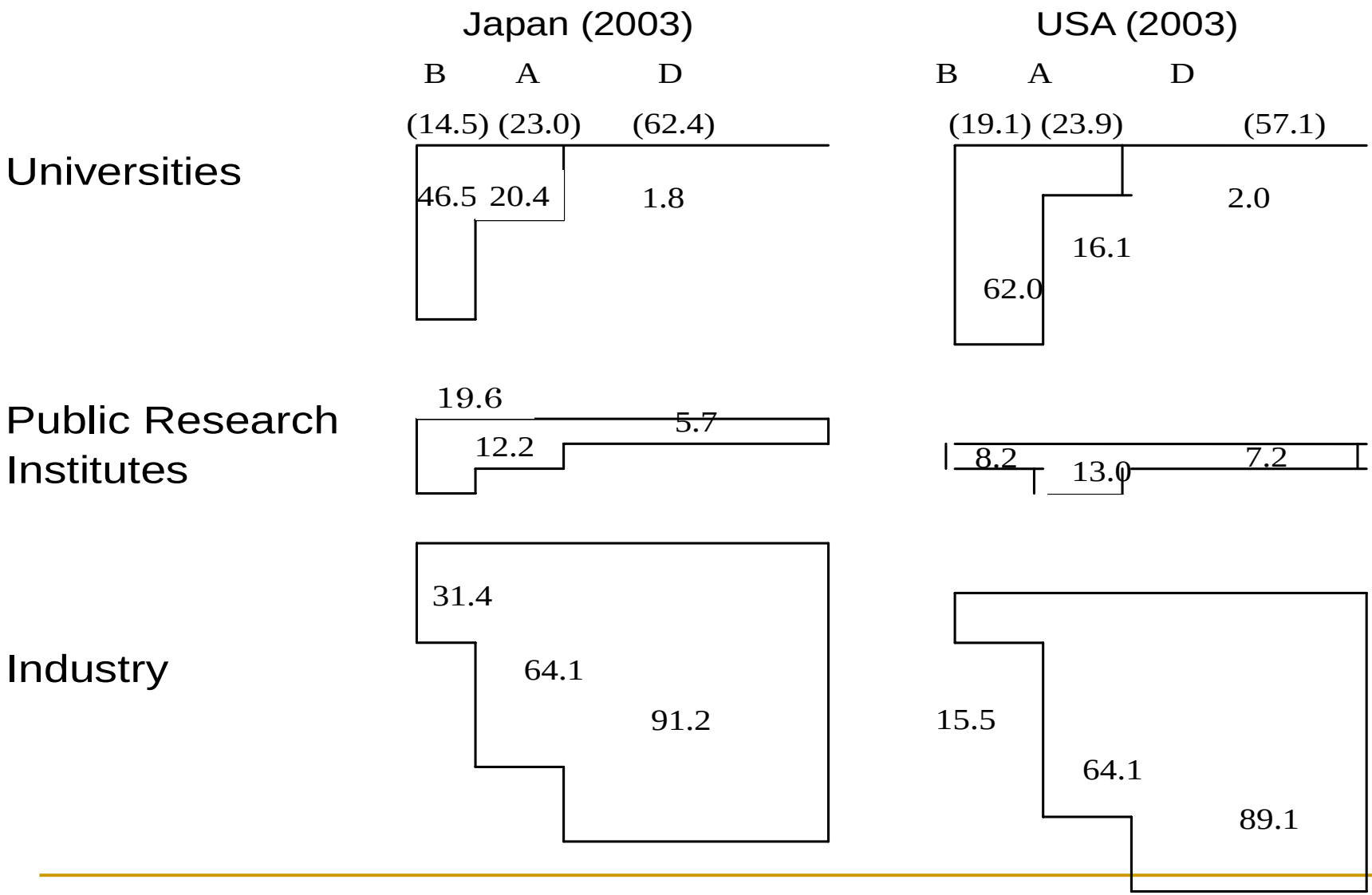
    - Academic Spin-offs -- From “Collaboration” to “Cross-over” --

- Concluding Remarks

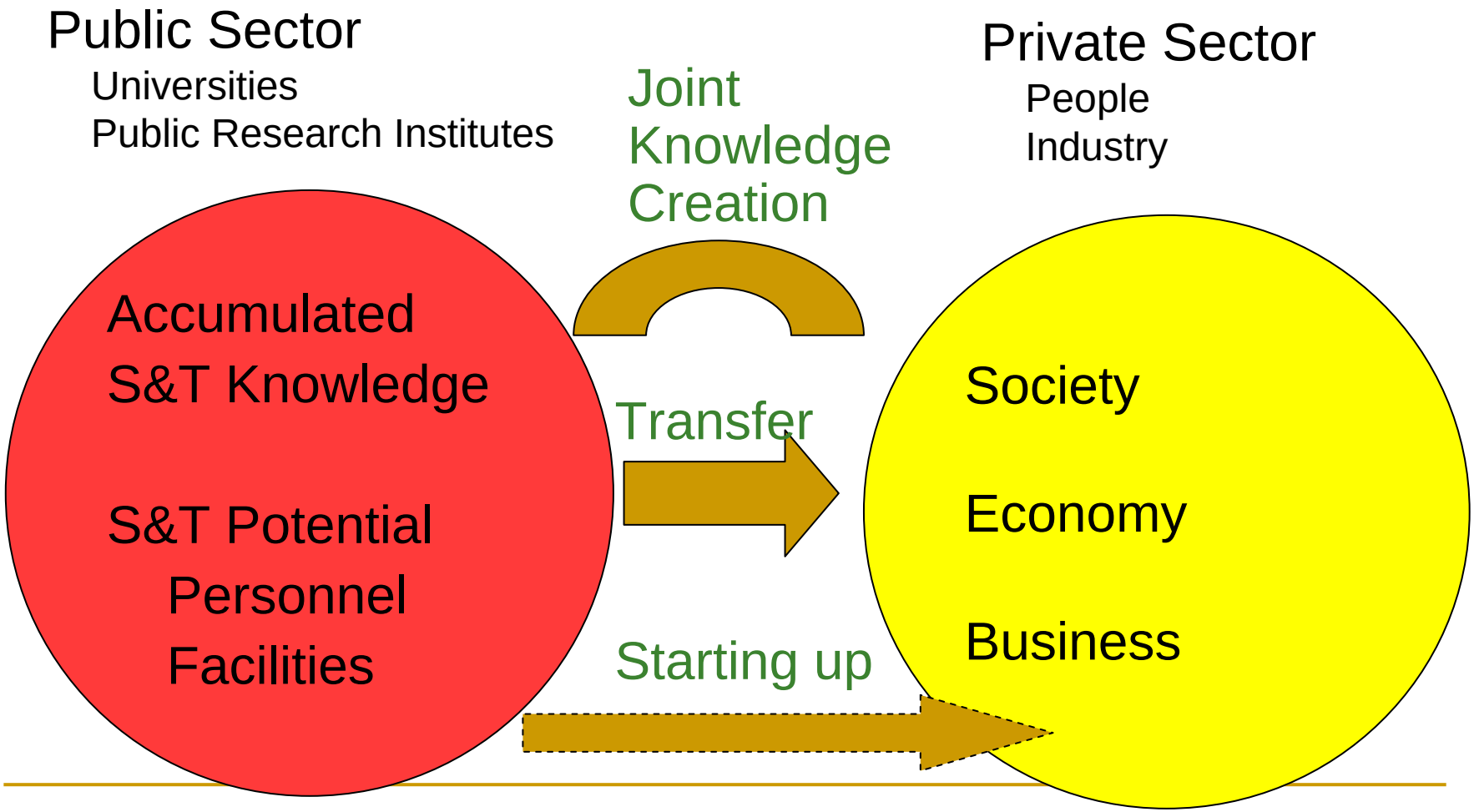
University-Industry Partnerships in a National Innovation System

Role Charts

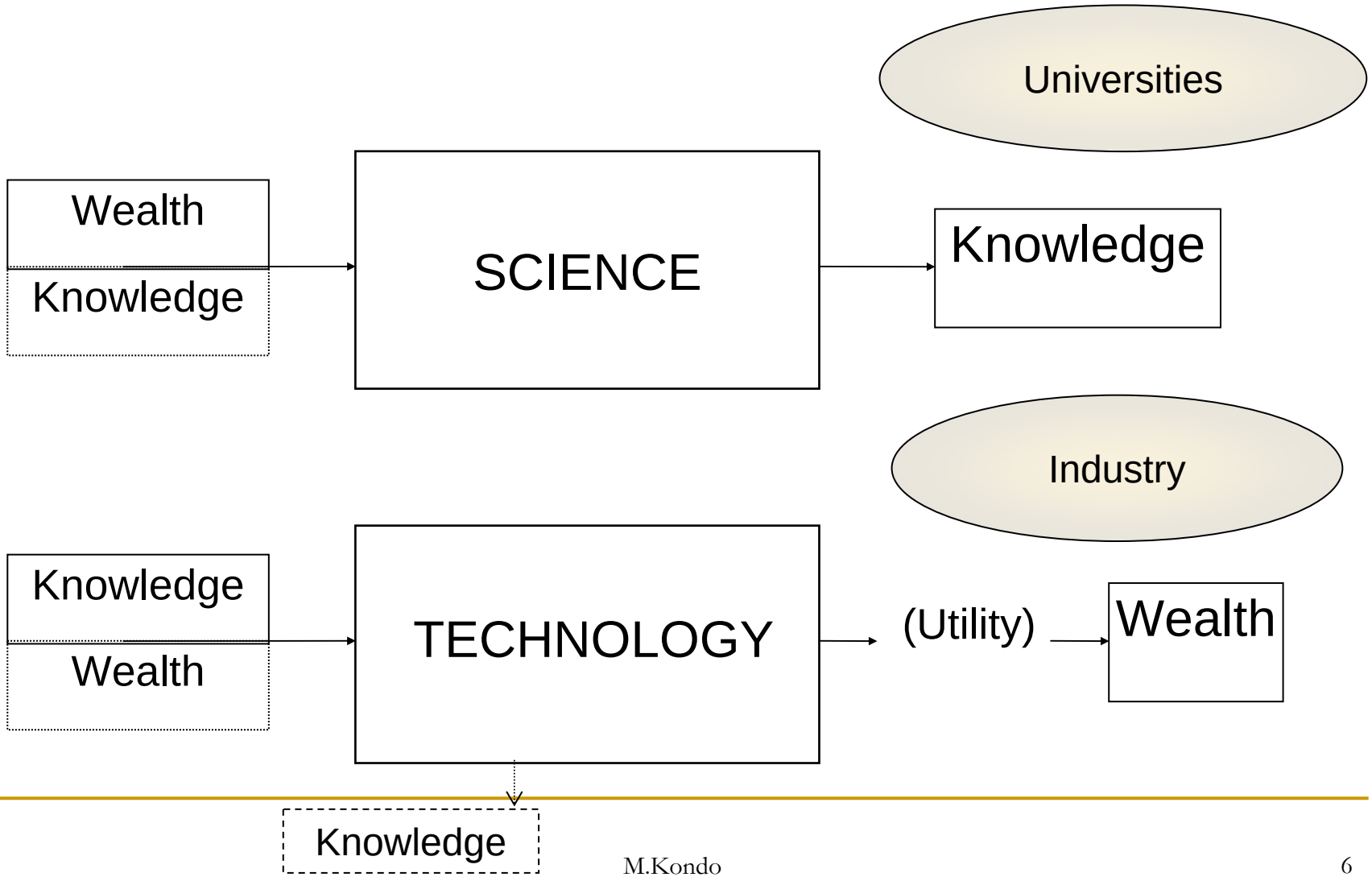
(unit: %)



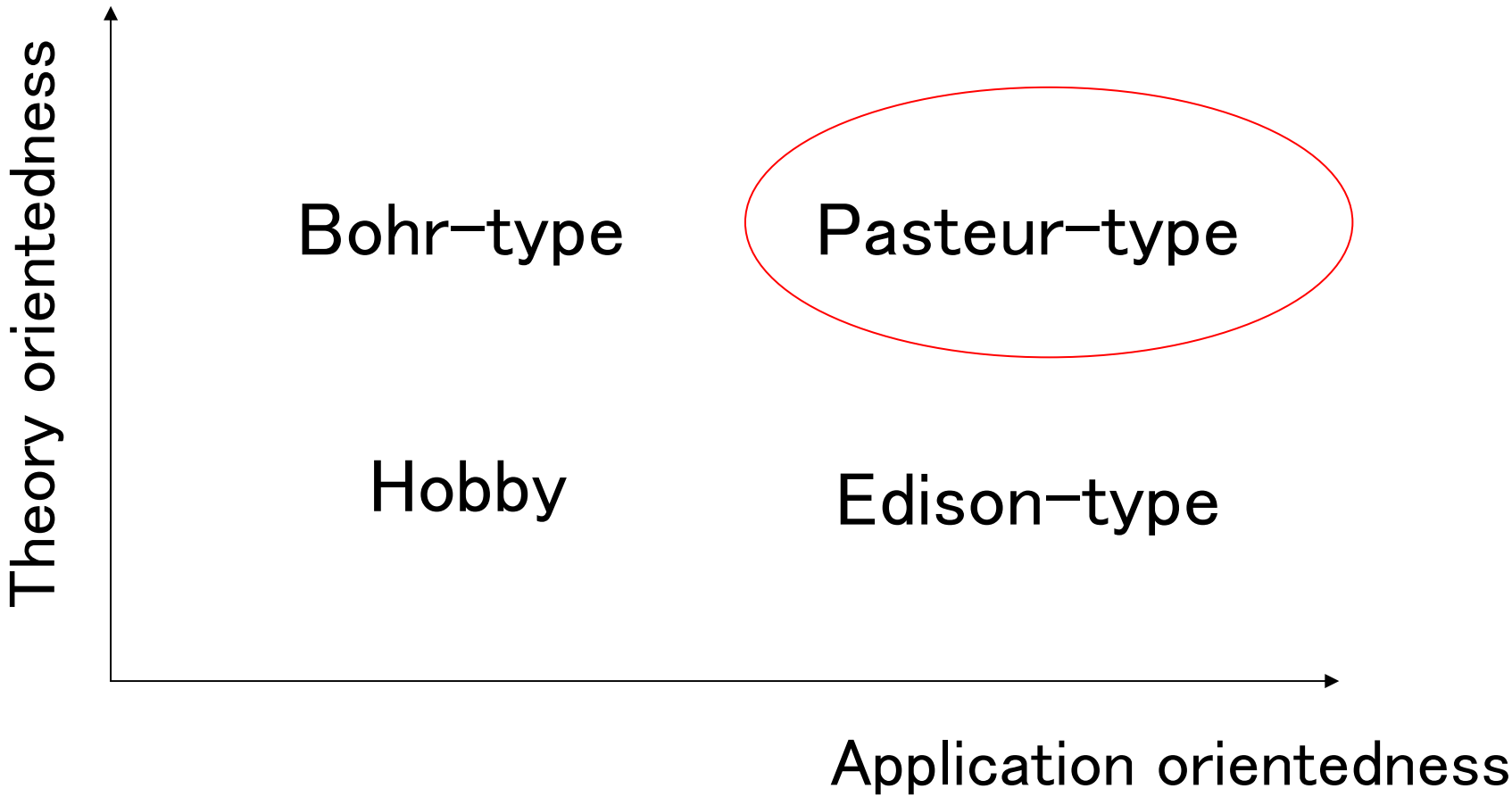
Question:
How can we utilize S&T for society, economy and business in a national innovation system?



Science vs. Technology



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

Revenue of RIKEN

year	1927		1939		1940	
	thousand yen	%	thousand yen	%	thousand yen	%
R&D	13	2.0	264	7.1	137	3.8
patent royalty	0	0.0	1793	48.4	2182	60.4
production work	206	31.2	53	1.4	44	1.2
stock operation	37	5.6	740	20.0	6	0.2
rent	6	0.9	1	0.0	1	0.0
interests and dividends	143	21.7	793	21.4	876	24.3
subsidies	250	37.9	0	0.0	0	0.0
miscellaneous	4	0.6	61	1.6	367	10.2
total	660	100.0	3705	100.0	3611	100.0

Source: The author tabulated using the data from Saito, Ken, Research on a new concern RIKEN Industrial Group (in Japanese), Jichosha, January 1987.

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

Notes. 1. This classification is based on M. Kondo, Policy Innovation in Science and Technology in Japan –from S&T Policy to Innovation Policy– (in Japanese), *J of Science Policy and Research Management*, Vol.19, No.3/4, pp.132-140, 2004.
2. Facility and equipment usage is another form of partnership.

Policies to Promote University-Industry Partnerships in Japan

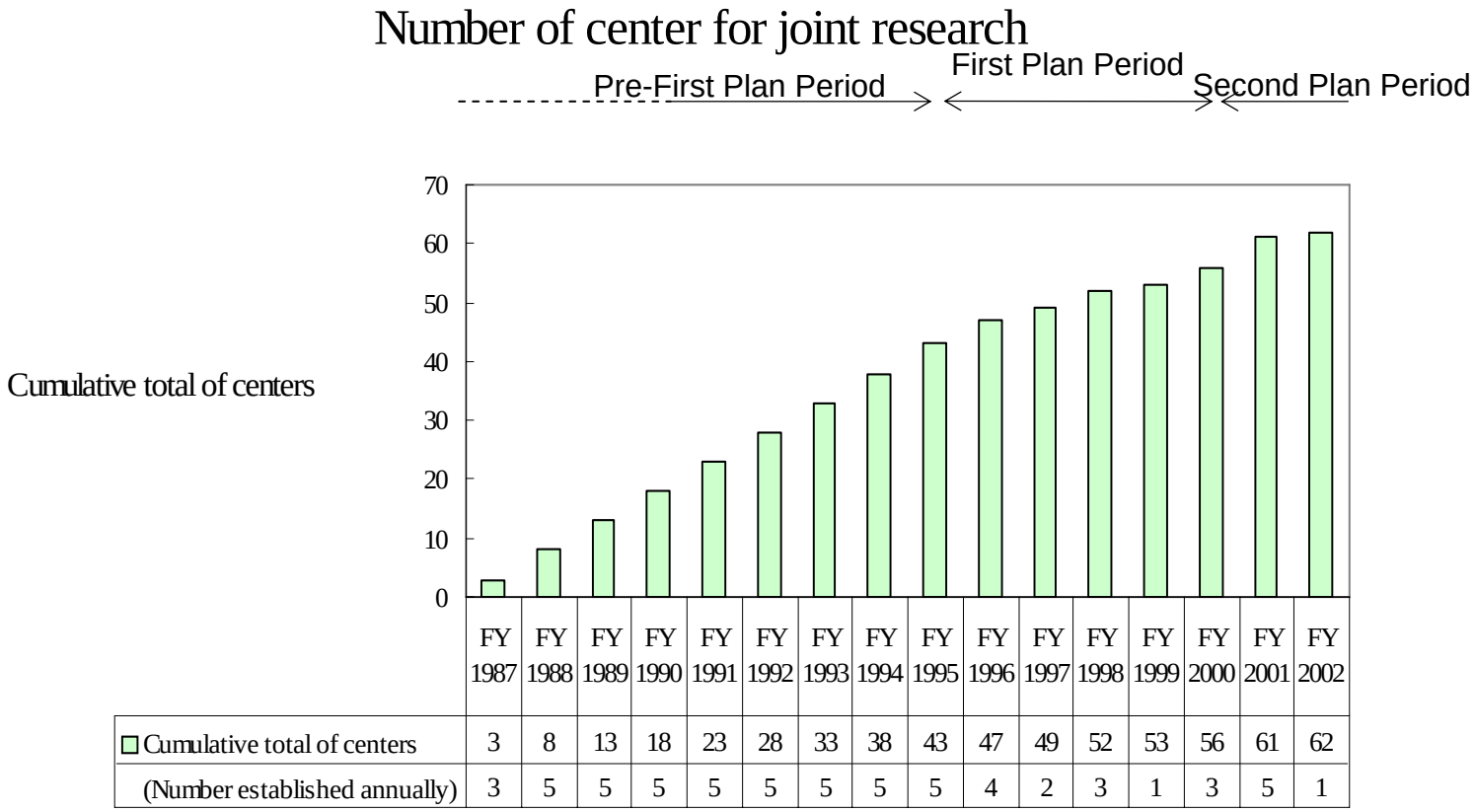
Joint Knowledge Creation
- Joint Research Centers
- Research Grants for University-Industry Collaborative Research

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

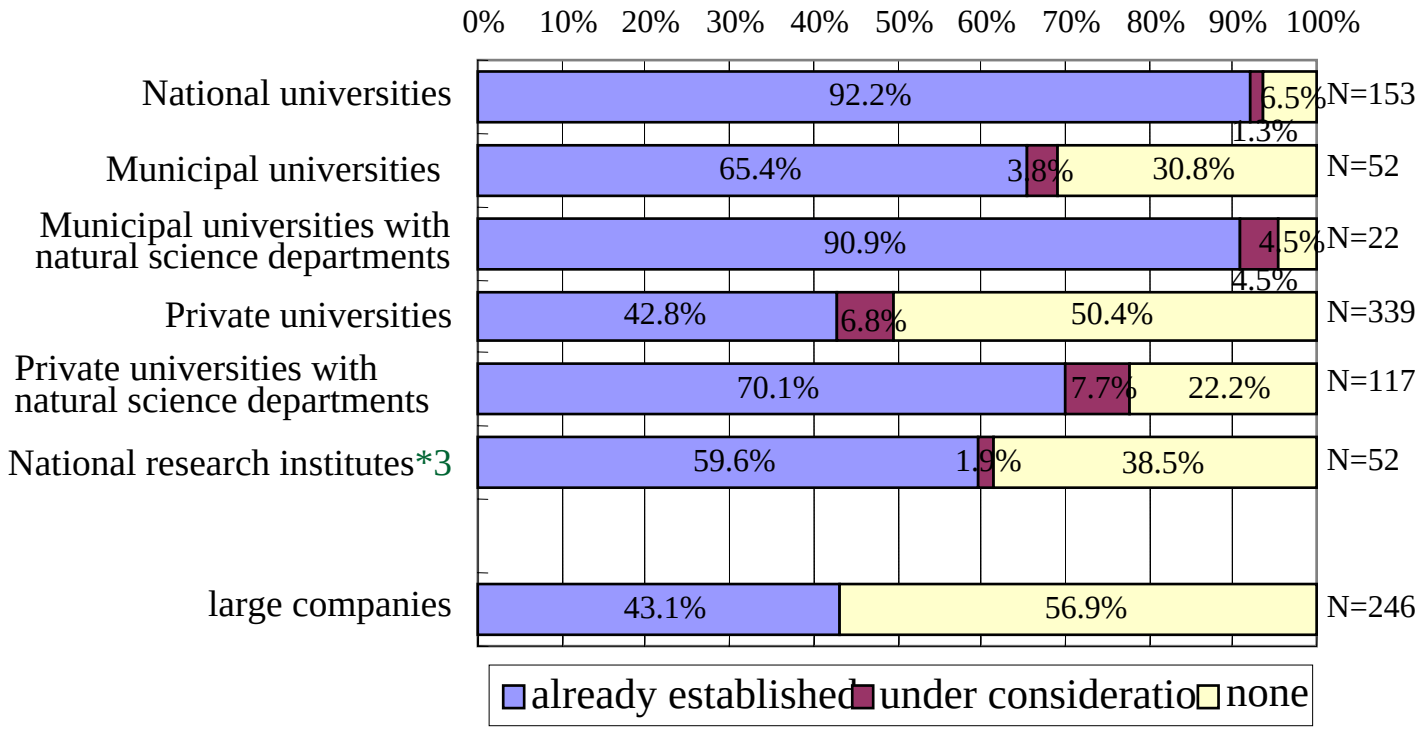
Joint Research Centers at National University



	FY 1987	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002
Cumulative total of centers	3	8	13	18	23	28	33	38	43	47	49	52	53	56	61	62
(Number established annually)	3	5	5	5	5	5	5	5	5	4	2	3	1	3	5	1

Source: MEXT Website

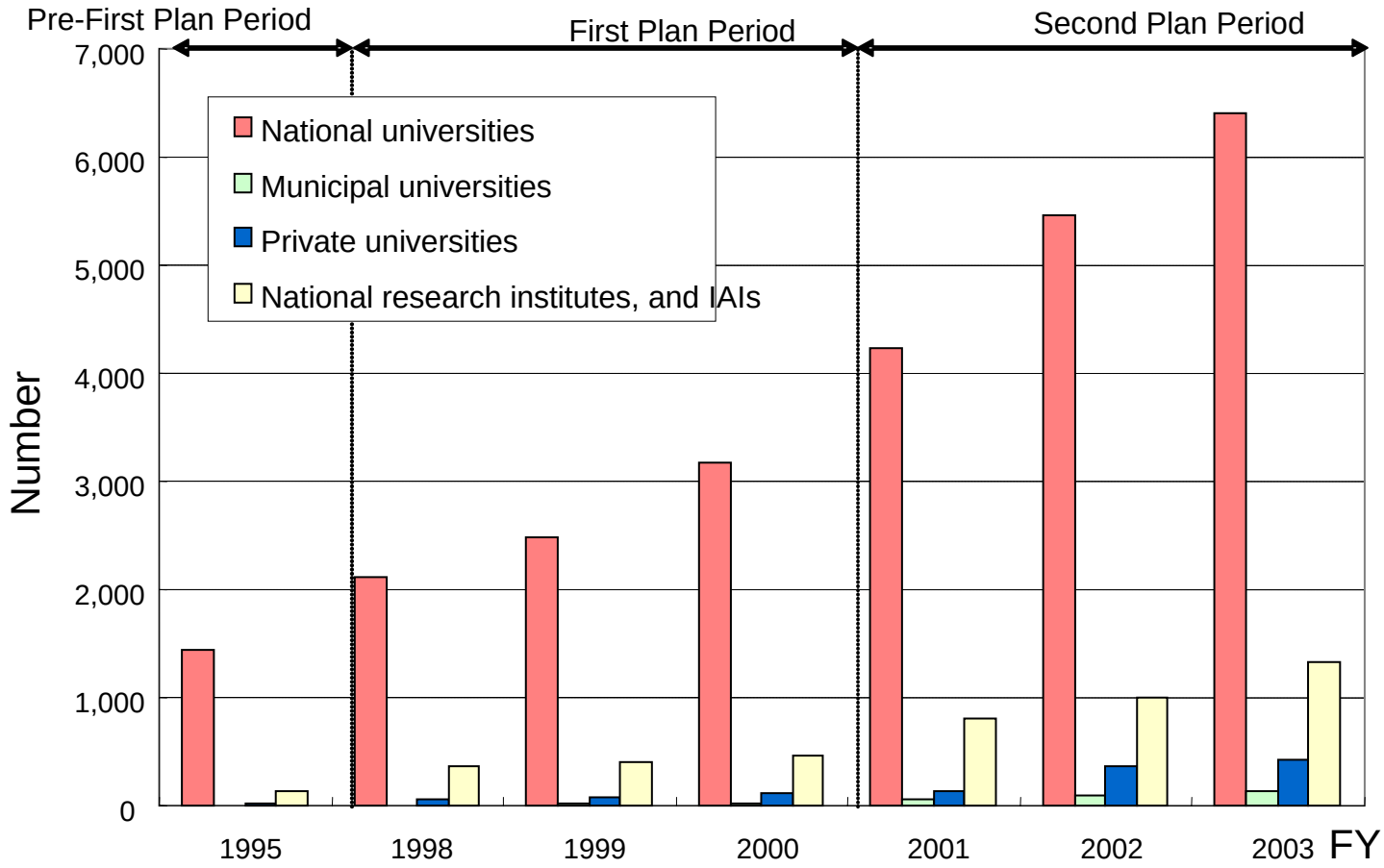
Offices for University-Industry Cooperation



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

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 -

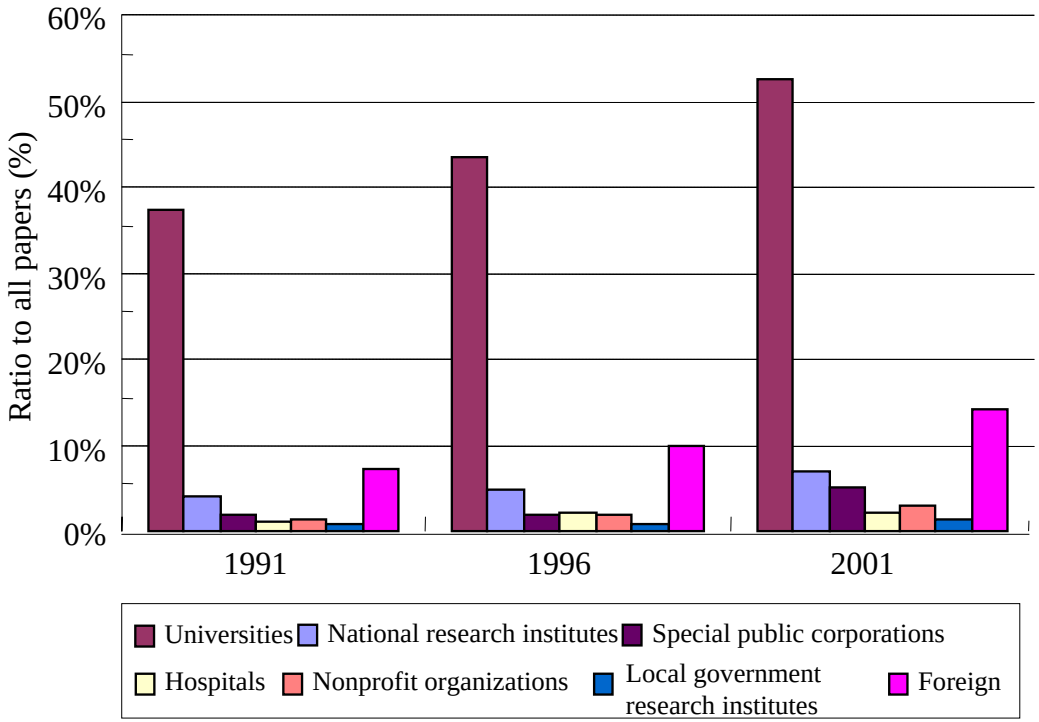
- Deepening
  - Number of joint research projects per company increased.
  - Joint research projects with large budget increased.
  - Joint research in the same prefecture increased in terms of number and total budget.

- 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.

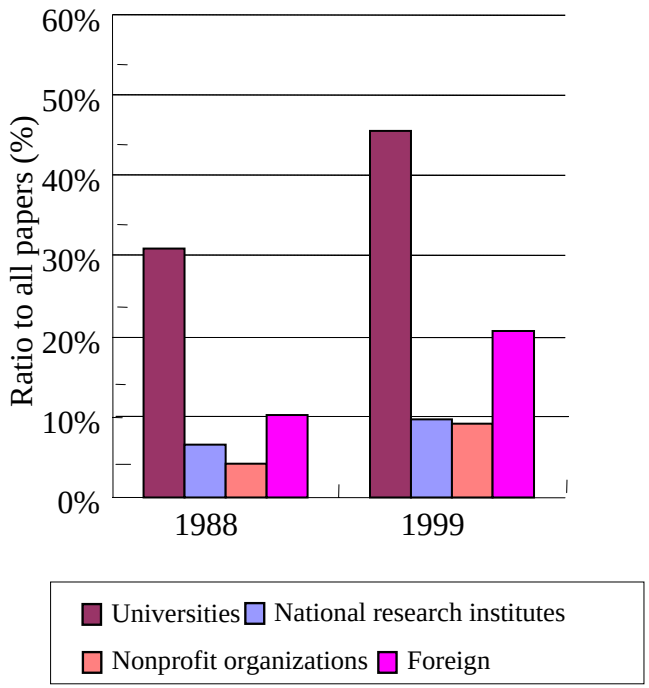
Source: K. Sakamoto and M. Kondo, The Analysis of University-Industry Research Collaborations by Time Series and Corporate Characteristics (in Japanese), Development Engineering, Vol.10, 11-26, 2004.

Coauthorship between Company Researchers and University Researchers

Ratio of joint-authored papers between companies and other sectors in Japan



Ratio of joint-authored papers between companies and other sectors in U.S.



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

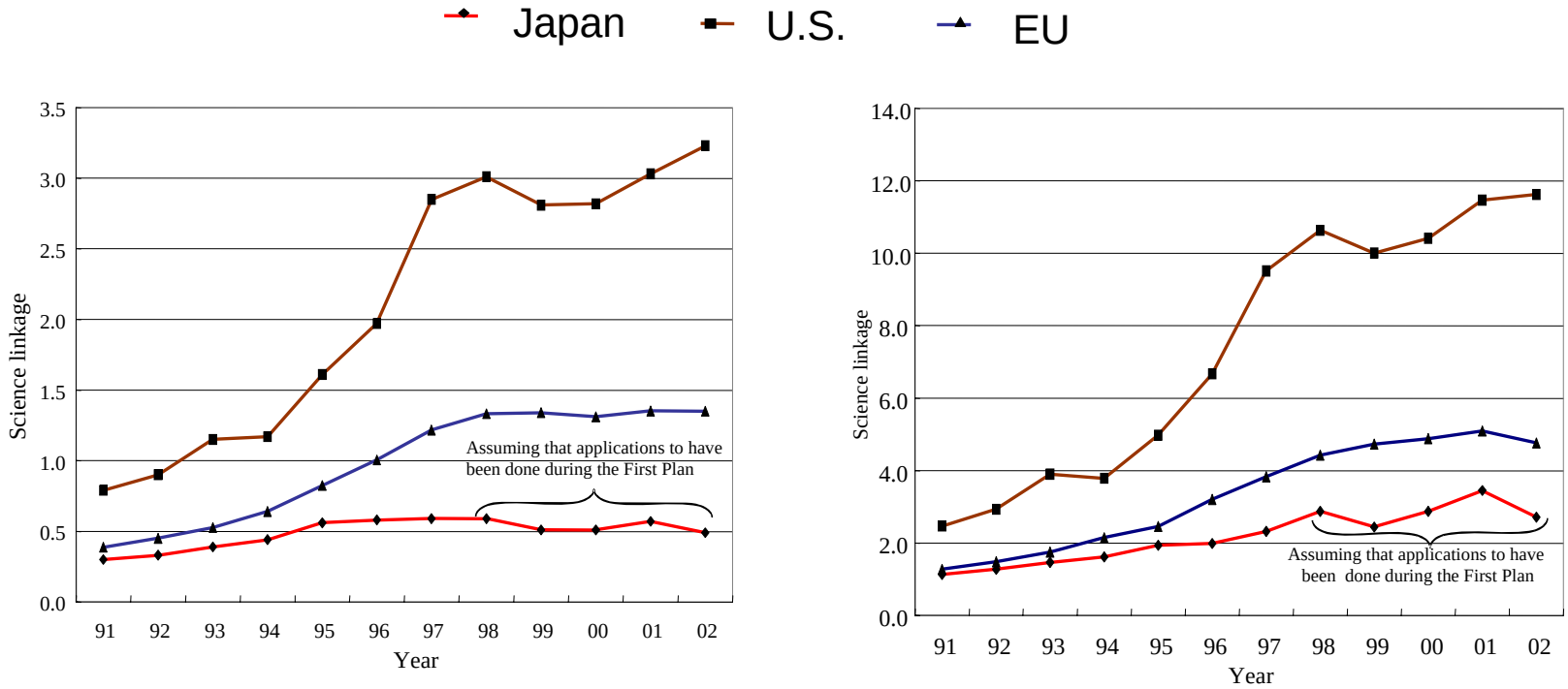
(U.S.)NSF, "Science & Engineering Indicators: 2002"

Source: NISREP REPORT No.74 (2004)

Science Linkage in U.S. Patents

All Areas

Life Sciences



*: "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.

Data: CHI Research Inc. "International Technology Indicators 1980-2002"

Source: NISTEP

University Licensing
(Japan-US Comparison)

	Japan	US	Ratios
R&D	3.3 trillion yen (in 2002)	5.4 trillion yen (in 2002)	1.6
Patent Application	1,680 (in 2003)	6,509 (in 2002)	3.9
Licensing Contracts	531 (in 2003)	3,739 (in 2002)	7.0
License Income	0.55 billion yen (in 2003)	145 billion yen (in 2002)	264
cf. Academic Spin-Offs	179 (in 2003)	364 (in 2002)	2.0

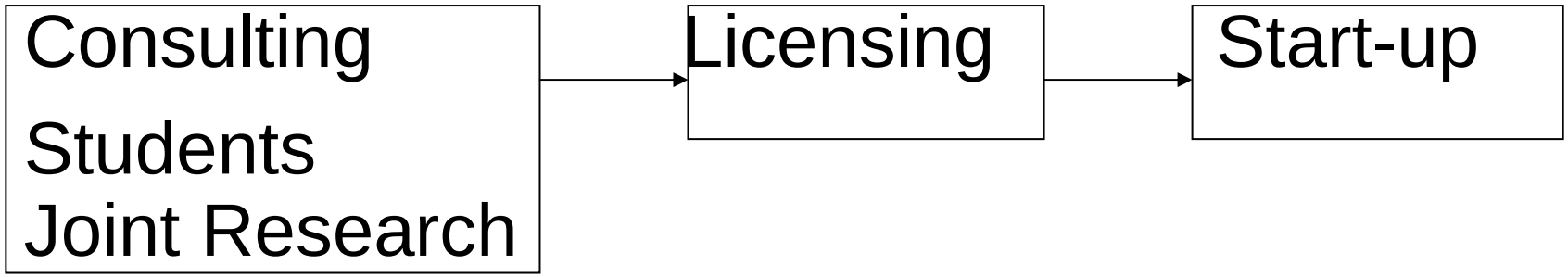
Source: NISTEP

Academic Spin-Offs

Stage-by-Stage Penetration

An Enterprise to Overseas Market

A Professor (or a Researcher) to Market/Society

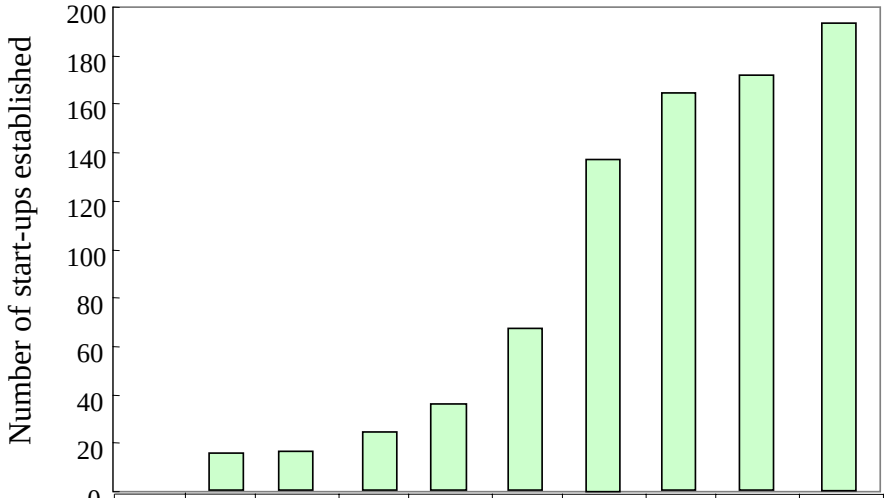


Source: M. Kondo, Policy Innovation in Science and Technology in Japan –from S&T Policy to Innovation Policy-- (in Japanese), *J of Science Policy and Research Management*, Vol.19, No.3/4, pp.132-140, 2004.

Academic Spin-Offs in Japan

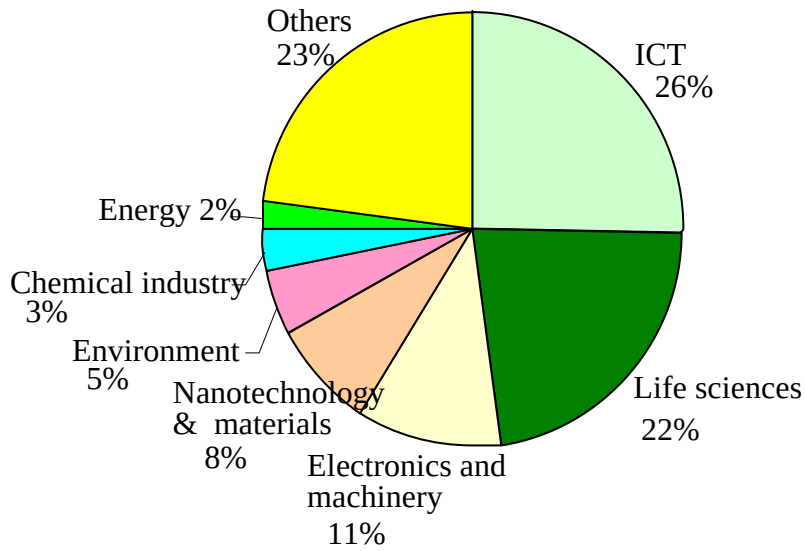
Academic Spin-Offs

*Accumulated total is 916 as of August of 2004.



	Up to 1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Number of start-ups annually established	38	14	15	22	33	62	127	152	159	179

Academic Spin-Offs by Areas

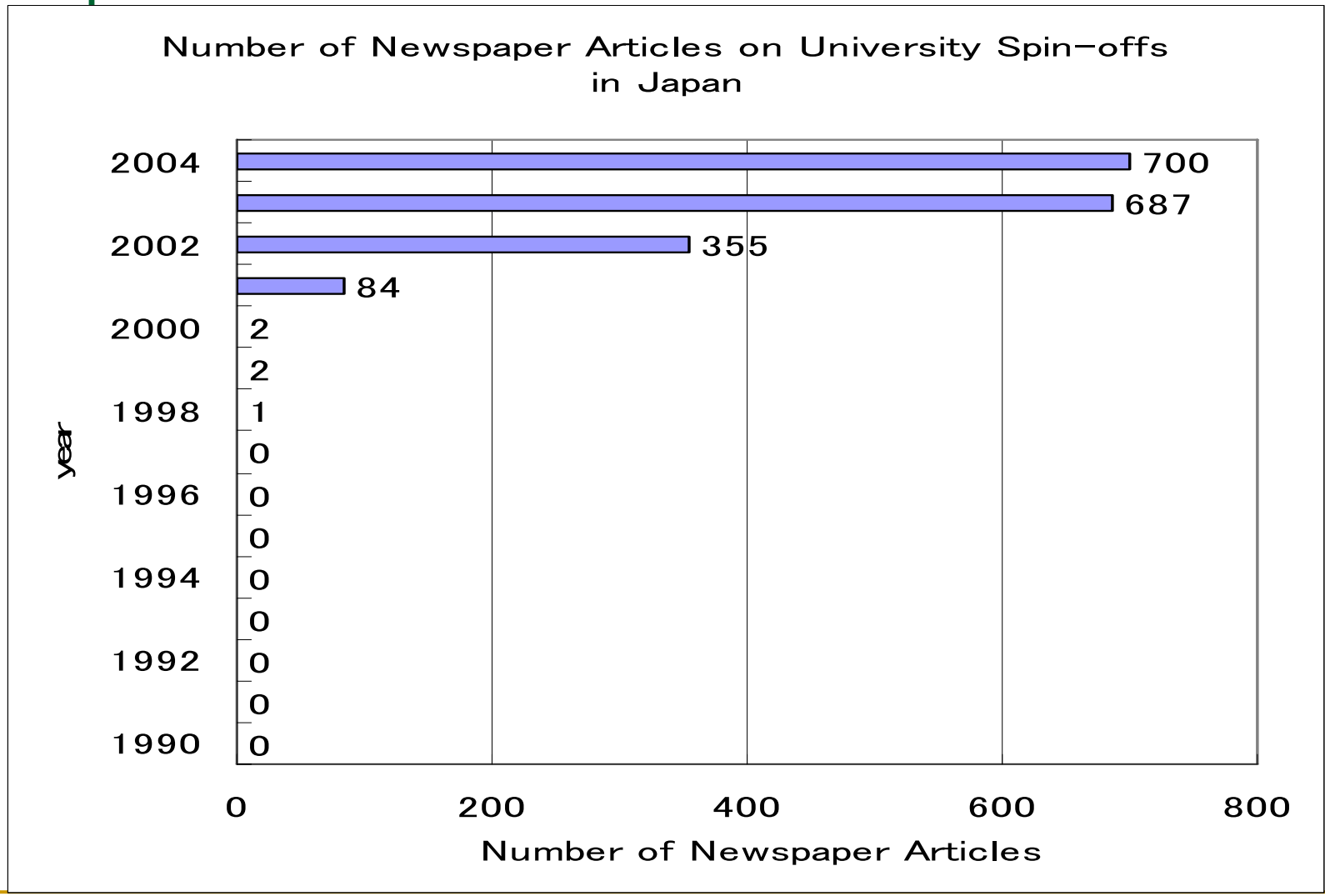


*: Breakdown of 916 companies as of August 2004.

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

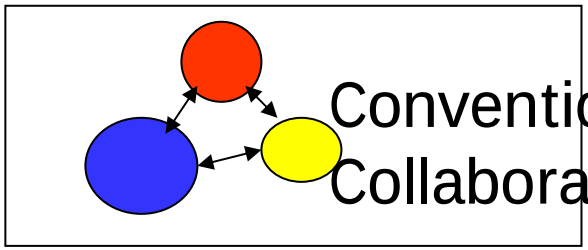
Source: NISTEP

Newspaper Articles on “University Spin-offs” in Japan



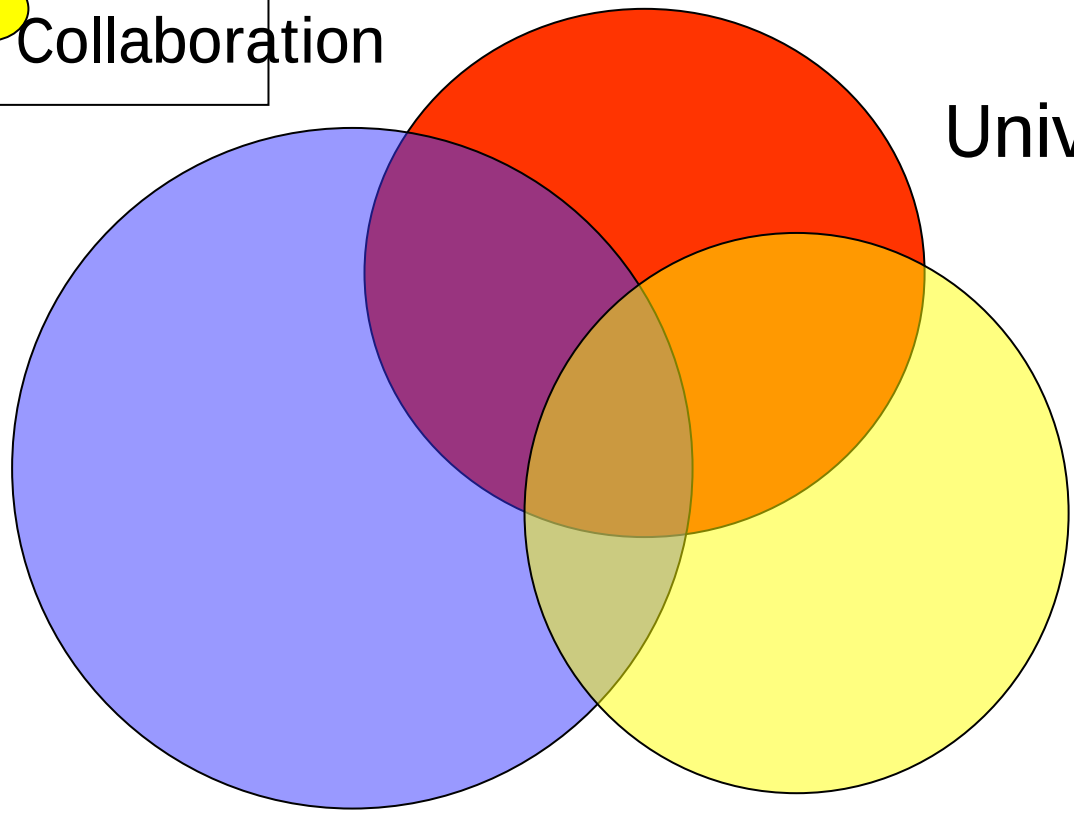
Note. The number of articles in four newspapers published by NIKKEI.

Cross-over among Industry, Universities and Public Research Institutes



Conventional
Collaboration

Cross-over



Source: M. Kondo, University spin-offs in Japan, Asia Pacific Tech Monitor, March-April 2004, pp.37-43, Asian and Pacific Centre for Transfer of Technology, ESCAP, UN.

Profiles of Academic Spin-off Founders

Table: Profiles of Founders

Founders	Ratios (%)
Faculty	**69.7**
of which professors	**44.2**
Students	**22.9**
of which doctor course students	**11.2**
of which master course students	**7.5**
of which undergraduate students	**3.0**
Researchers/technicians	**7.5**
Total	**100.0**

Source: FY2004 Survey.

Future Business of Academic Spin-offs

Future Business	
Intended Future Business	Ratios (%)
Licensing out	25.7
Product sales using OEM	22.4
Product manufacturing and sales	16.1
Contract research and design	14.6
Sales of developed patents	11.5
Others	9.6

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