# Implementing New Patterns of University-Industry Collaboration in Japan:  Lessons from the U.S.

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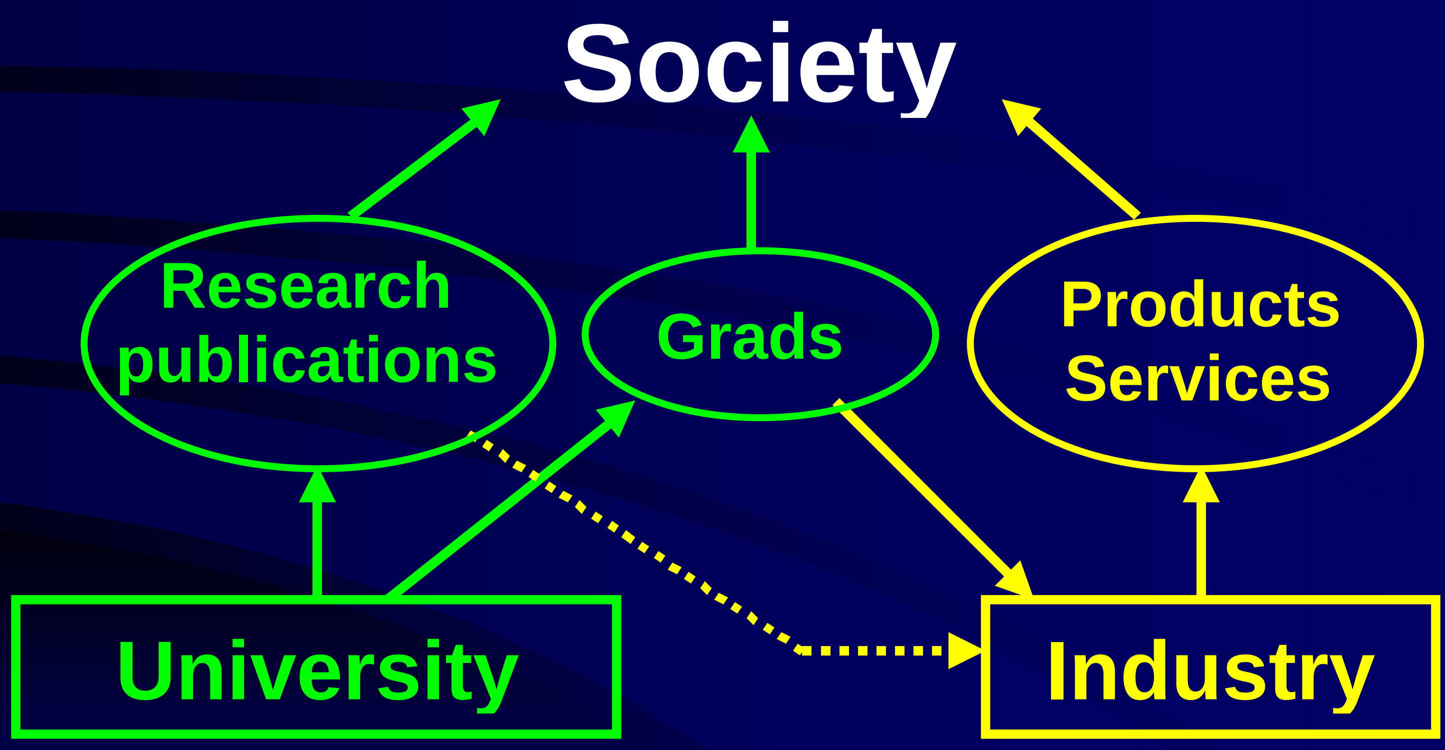
# Outline

- University and industry roles in innovation
- New demand for better early-stage innovation
- Implementing new channels of university-industry collaboration

# The traditional model:
## Independent contributions to society



# New demands: University-industry partnership

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# (Explanation and comments about previous slide)

- University and industry continue to produce their traditional output
- Through real-time relationships and direct technology transfer, university and industry together will produce new opportunities, such as new ventures and new industries
- Governments (central, regional, and local) provide a stable environment and other encouragement for positive cooperation to take place
  - Government also protects the interests of the people
- (National) government provides important S&T funding

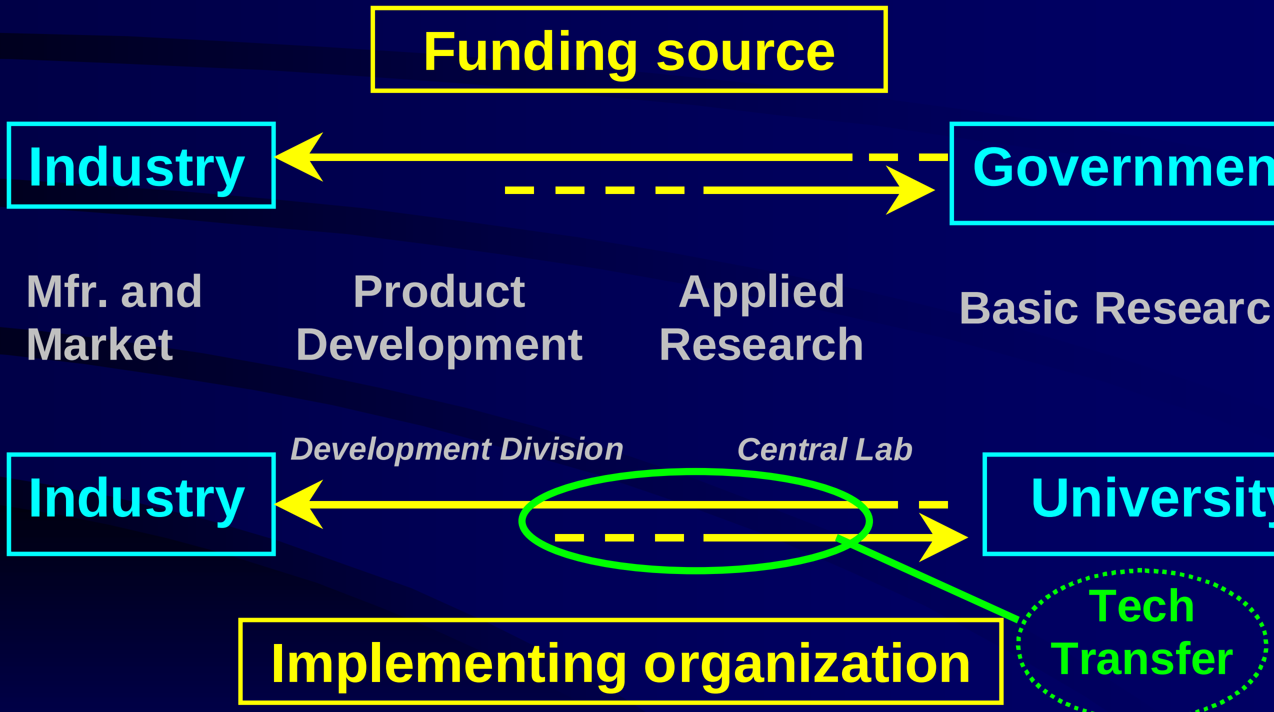
## Why these new demands?
## It is all about

# Innovation

# Innovation

- "The process leading from the discovery or invention of a new idea or technology to its practical implementation (often via commercialization)"
- Early stage (basic research): typically without a practical implementation (product) in mind
- Late stage (development): driven by technology and cost demands of a real-world application
- Usually, different people are involved at the different stages

# University and industry roles in an innovation system



# (Explanation of previous slide)

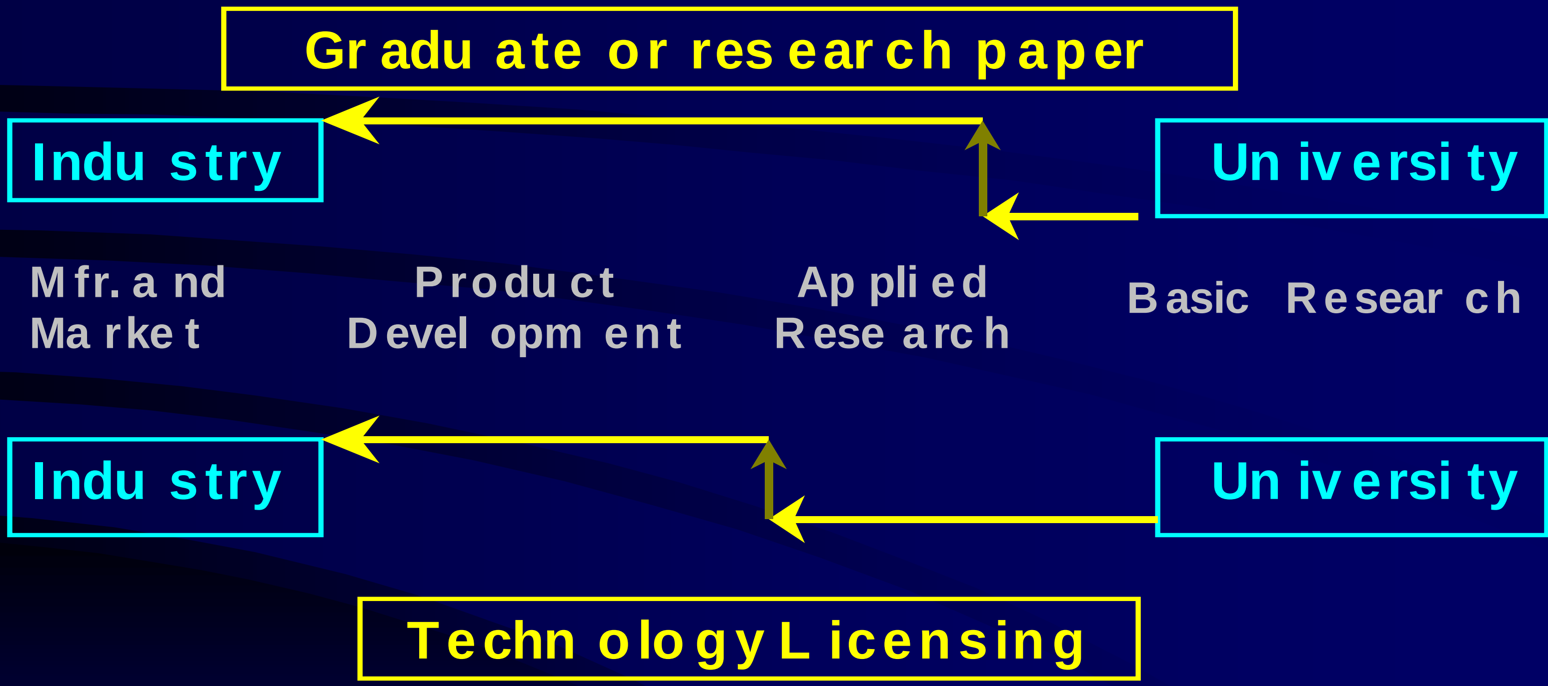
- <u>Natural division of labor</u>
  - Basic research: government funds, university conducts
  - Product development: industry funds, industry conducts
- <u>Transition in innovation system at Applied Research stage</u>
  - Both industry and government fund applied research
  - Both industry and university conduct
- <u>Technology (knowledge) transfer</u>
  - Internal to industry: from research lab to development group
  - From university to industry

# Patterns of university-industry technology transfer (U.S.)

- Linear hand-off (traditional path)
  - Students graduate and transfer knowledge to companies
  - Public domain academic papers transfer knowledge from university researchers to industry R&D community
- Spillover (since 1980's)
  - Real-time knowledge-sharing between university and industry
  - Channels: visitors, joint R&D projects, open university labs, etc.
- Technology marketplace (growing since 1990's)
  - Technology licensing, start-up company creation

*Rosenberg and Nelson (1996)*

# Technology licensing is a type of linear hand-off (at a later stage)




*Transfer is relatively instant, one-way*

# Technology spillover is different

# Society has new needs: Better innovation systems at the early stages

# Why are there demands for better innovation systems in Japan?

- Innovation is critically important for any advanced economy
- Now:  an era of rapid, revolutionary technology progress and sudden new markets
- Industry faces ever more severe economic conditions
  - New worldwide competition, more knowledgeable customers require efficiency, sophisticated planning
  - High land and labor prices in comparison with Asian countries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# Demands for new innovation systems in Japan - 2: Economic restructuring

- Shift from production-based to knowledge-based competitiveness
- Ending protection of inefficient industries
- Shift away from lifetime employment
- Rising government deficits
- Population getting older

# Nature of the demands for better innovation systems in Japan

- Shift of focus to earlier stages of innovation
  - Japan has already led the world to better late-stage innovation (development and commercialization)
- Some of the demands:
  - Quicker, more flexible response by universities to industry (and society) needs
  - More practical output from universities: IP, ventures
  - Better knowledge acquisition by companies from universities
  - Identify and develop new business ideas more rapidly

# Japan today: similar to U.S. in early 1980's ?

- In U.S.
  - Spillover model stimulated by concerns about competitiveness
    - How to compete against (then) MITI consortia
  - Yet, had to avoid anti-trust problems
  - U.S. universities had strong reputation in science, but technology transfer to industry seemed "broken"
- But, differences:
  - Japan now concerned about quality of universities
  - No Cold War to justify large government spending in university research (less leverage for industry money)

# For better early-stage innovation: industry needs from university

*Industry <u>needs earlier-stage knowledge</u> across broader areas, but <u>cannot afford to pay full cost</u> of in-house early-stage research*

- **<u>Graduates</u> (especially Ph.D.s) who learned expert knowledge at the university (not just general education) that is relevant to industry**
- **<u>Occasional access to faculty knowledge</u> of technology potentials and limitations, worldwide efforts in related areas**
- **<u>Low-cost involvement with exploratory research</u>: off-road technologies, new devices, etc.**
- **<u>Forum for dialog with faculty to identify mutual goals</u>, have influence in the directions of university research**

# For better early-stage innovation: university roles change

| *Traditional: Lifetime employment* | *New: Individuals manage own careers* |
|---|---|
| ♦ Industry hires "younger," does more on-the-job training | ♦ Universities need to provide more Ph.D.s with relevant skills, knowledge |
| ♦ Relatively low career mobility across firms | ♦ University programs for mid-career students |
| ♦ Universities focus on general education, branding | ♦ Universities must prepare grads for more difficult competition for jobs |
| ♦ Little student interest in "real world" | ♦ Students need real-world experience, knowledge |

# Summary to this point

- <u>Attention to earlier stages of innovation</u> brings university-industry relations to the front
- Society needs call for <u>different types of university-industry relationships</u> than were found in Japan up to now
  - Closer communications
  - Substantive cooperation (joint research and education projects)
  - Two-way knowledge exchange in real-time
- Japan may be able to learn from the <u>"partnership" frameworks</u> found in the U.S.

# Implementing new patterns of university-industry relations

# Some channels for substantive university-industry collaboration

- "Sponsored projects" (contracted research)
- Visiting researchers from industry in the university
- Industry "mentors" for Ph.D. students
- Gifts by companies for "unrestricted" support of research
- Membership in "industry affiliate programs" and "research centers"
- Use by company researchers of university labs
- Technology licensing and start-up company creation

# External Funding at Stanford's School of Engineering

**2002-03 Sources of Funds**

$161.8 M (of which, about $93.1 M was used for research)

| | |
|---|---|
| ♦ University funds | 22.0% |
| ♦ Endowment income | 12.0% |
| ♦ Sponsored projects | 42.0% |
|   ♦ About 3/4 sponsored by U.S. government | |
| ♦ Other (gifts, centers, licensing, etc.) | 24.0% |

# What the Statistics Mean: Different Roles for Different Funding

- "Sponsored Projects"
  - Largest source of funds, but most is from governments and private foundations (very little from companies)
- Funding from Companies
  - Most goes to research centers, other industry affiliate programs, and gifts to support individual faculty research
- Industry is looking for a different kind of benefit than found in sponsored projects

# Sponsored projects

- Formal agreements, specific deliverables, itemized budgets, negotiable IP rights
- At Stanford, charged full overhead (~ 58%)
- Appropriate when company knows the outcome it wants
- No “windows” to work other than the specific project
- May not involve much real-time knowledge exchange during the research period

# Knowledge transfer patterns

## Sponsored projects

- Focus on research results (deliverables)
- Transfer by traditional patterns
  - Research papers, reports
  - Graduates
- Transfer by licensing

Pattern is one-way transfer, mostly at project end

## Research centers

- Focus on industry-relevant research in progress
- Transfer by people-to-people relationships, e.g.:
  - Industry mentors for Ph.D. students
  - Visiting scientists
  - Strategy discussions

Pattern is real-time, two-way knowledge exchange

# Industry visitors and mentors

- Most effective when the industry person has own research agenda that synergizes with projects in professor's group
- Gains insight from (grad) students, with some oversight by professor
- Gives valuable real-world perspectives (cost, difficulty in mass manufacturing situations, etc.)
- Usually involves payment of large fee by company to support professor's research
  - Resources to professor in exchange for demands on research group time and effort

# “Research centers” and affiliate programs

- Provide an important type of funding
  - Relatively unrestricted
  - Enable a professor to try new things, establish new research agendas (that may later receive much larger funding from government, etc.)
- Typically interdisciplinary, focused on a type of problem or approach (“integration”) or application (“network”)
- Serve as interface between (business-driven) industry and (academically-driven) academic departments
  - Departments handle all academic matters
  - Centers administer visitor and mentor programs, organize visits to companies, meetings, etc.

# Sponsored projects versus research centers - (2)

| Sponsored project | Research center |
|---|---|
| ♦ Appropriate when aiming at <u>specific deliverable</u> | ♦ Better for <u>exploratory research</u>: may be critical |
| ♦ <u>Bilateral contractual relationship</u> | ♦ <u>Multi-lateral partnership</u> (companies & professors) |
| ♦ Company has greater "say" over use of funds | ♦ Company has little control over use of funds |
| ♦ Provides <u>insights only into the funded project</u> | ♦ Typically provides <u>insights across many faculty areas</u> and close involvement in one or two |
| ♦ <u>May provide exclusivity, but not usually secrecy</u> | ♦ <u>Non-exclusive access</u> |

# Industry use of university labs

- Provides income to university (lab use fees)
- Requires university lab to think like a service-provider
  - Eliminates "ownership" of lab by one or two professors
  - Down-time is usually more damaging to companies than to Ph.D. students
  - Hire professional staff for maintenance, repair that used to be done by Ph.D. students
- Why would industry want to use a university lab?
  - Greater flexibility, access to broad range of facilities and knowledge, often without capital costs

# Technology licensing: not really university-industry collaboration

- <u>IP is a by-product of university research:</u> commercialization is not the main goal
- Licensing is a <u>business proposition</u>: industry buys university output
  - Not concerned with future research or results
- <u>Royalty income</u> provides important incentives
  - To students and professors, and departments
  - To companies: if they don't pay, they may not actively commercialize the invention
  - Often income is only in the future: years after research is over
- <u>Use by industry</u> of university IP is a concrete indication that university research benefits society

# Case study:
# Center for Integrated Systems

- Membership based:  full-partner yearly fee $150K
- Nineteen member companies at presentf
- Allocations from membership fees:
  - 2 x $45K “customized”:  one Ph.D. student and one “custom project” (Ph.D. student, industry visitor, etc.)
  - $30K to Seed Research pool:  for new faculty and to help faculty develop new areas of research
  - $30K program costs
- Framework creates multiple university-industry human relationships with joint substantive goals

# Why CIS is successful - 1

- <u>Mutual respect and cooperation</u>
  - Industry wants to be involved with <u>university</u> research
  - Faculty understand industry needs
- <u>Balancing of industry, university interests</u>
  - Selection of appropriate, exploratory projects
  - Separation of CIS from academic functions (admissions, graduation, faculty hiring)
- <u>Contribution of time, effort</u> by company and university personnel (beyond fees)

# Why CIS is successful - 2

- Value proposition:  companies can participate in pre-competitive research without paying full cost of the research:  $150K to join $2.5M pool
- Provides members with a window to even larger pool of interesting research
  - Stanford research of interest to CIS companies ~$25 M
- Quality and relevance of research
  - Long tradition of close ties to industry at Stanford

# Some concerns about university-industry relations

- Possible conflicts of interest
  - Divided allegiance
- Over-expectation of funds from licensing or other industry income
- Over-emphasis on applied technical fields (at the expense of natural sciences and humanities)
  - Continuing importance of government funding
- Necessary to invest resources in good university-industry relationships: continuing effort

# Summary and final points

- Society needs are causing changes in university-industry relations
- University-industry collaboration is not just pay-for-research
  - Instead, new types of relationships and interactions
- University and industry must keep their different perspectives but be flexible
- University-industry collaboration is not all that is necessary
  - Start-up companies, industry clustering involve more