

The 31st STAG Board Meeting

Theme II: From S&T Research to Industrial Applications

2.1 From University Research to Commercialization and Value Creation

Professor Liang-Gee Chen

Department of Electrical Engineering, National Taiwan University

August 31, 2011



Outline

1. Introduction
2. State of Taiwan's Scientific Research and Output
3. Commercialization and Value Creation of University Scientific Research
4. Challenges Faced by Taiwan in the Commercialization of University Scientific Research
5. Recommendations and Conclusions



1. Introduction

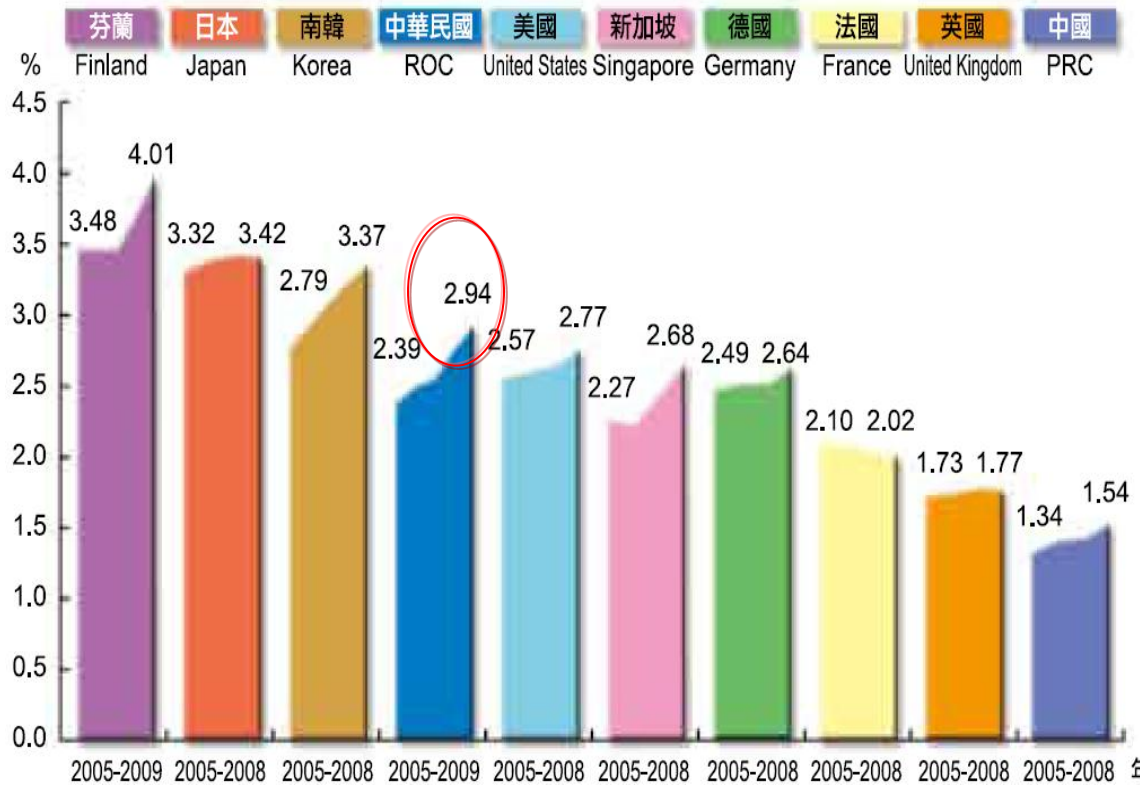
- Starting with advanced research at AT&T Bell Lab in 1993 ...
- NTU, ITRI technology transfers, experience with start-ups....
- Knowledge and technological innovation are able to create value, underpin S&T progress and help power industrial development.
- Universities are the cradle of new knowledge and are an important hub for creating new technology. They should serve as a fountainhead for generating value for industry and society.



2. State of Taiwan's Scientific Research and Output (1/10)

-- Taiwan's Scientific Research Funding Meets International Standards

R&D Expenditures to GDP for Major Nations



- **Major Nations: Finland 4.01%, Japan 3.42%, South Korea 3.37%, Taiwan 2.94% (US\$11.39 bln in 2009), China 1.54% (US\$121.427 bln in 2008)**
- **State of Investment: Gov't funding as a ratio to GDP is comparable with international levels. In future, research efficiency and effectiveness should be stressed.**

Source: National Science Council's 2010 S&T Statistical Highlights



2. State of Taiwan's Scientific Research and Output (2/10)

--Historical Investment in Scientific Research

Category \ Year	2005	2006	2007	2008	2009
National R&D Funding (US\$1 mln)	8527.21	9421.20	10190.3	10707.2	11389.5
National R&D Funding as Percentage of GDP (%)	2.39	2.51	2.57	2.78	2.94
National R&D Funding – Based to Sources of Funding (%)					
Corporate Sector	66.9	67.2	66.8	70.4	69.7
Public Sector	31.5	31.4	29.9	28.2	28.9
Other Domestic Sectors	1.5	1.4	1.3	1.3	1.3
Foreign	0.1	0	0	0	0
National R&D Funding – Based on Execution (%)					
Corporate Sector	67	67.5	69.1	70.7	70.1
Public Sector	21	19.9	18.3	16.8	16.8
Higher Education Sector	11.4	12.2	12.2	12.2	12.8
Private Non-Profit Sector	0.5	0.4	0.4	0.3	0.4

Source: National Science Council's 2010 S&T Statistical Highlights



2. State of Taiwan's Scientific Research and Output (3/10) -- State of Research Manpower (2009)

- The higher education sector has the largest amount of manpower holding PhDs (over 80% of manpower at academic and research institutions have PhDs)

2009		Research Manpower (Person-Years)			
		Total	PhDs	Master's	Bachelor's
Ex ec uti on	Corporate Sector	73,505(61.7%)	3,346(15.9%)	39,802(62.5%)	30,357(87.9%)
	Public Sector	14,390(12.1%)	4,261(20.3%)	7,888(12.4%)	2,241(6.5%)
	Higher Education Sector	30,712(25.8%)	13,156(62.7%)	15,735(24.7%)	1,821(5.3%)
	Private Non-Profit Sector	578(0.5%)	219(1.0%)	239(0.4%)	120(0.3%)
Grand Total		119,185(100%)	20,982(100%)	63,665(100%)	34,539(100%)

Source: Data compiled by STAG from National Science Council's 2010 S&T Statistical Highlights



2. State of Taiwan's Scientific Research and Output (4/10)

--State of Commercialization of Scientific Discoveries

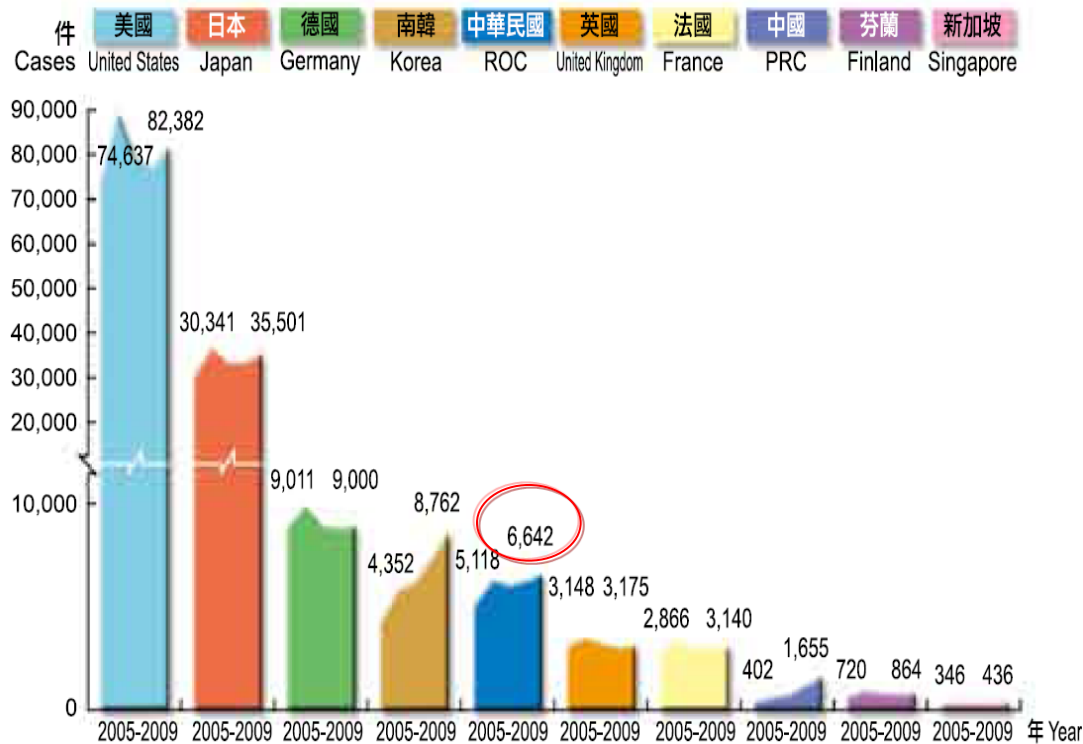
Category \ Year	2005	2006	2007	2008	2009
No. of Papers in Academic Journals					
SCI Papers (No.)	16,758	19,749	18,666	22,554	24,305
EI Papers (No.)	11,661	13,076	16,657	17,438	18,869
No. of Patents					
No. of Patents Submitted by ROC Nationals in the US and Approved	5,118	6,361	6,128	6,339	6,642
No. of Patents Submitted and Approved in Taiwan	20,626	23,228	22,218	12,867	14,138
Locals	9,124	11,431	10,578	6,364	7,445
Foreigners	11,502	11,797	11,640	6,503	6,693

Sources: National Science Council's 2010 S&T Statistical Highlights; 1.SCI Papers : National Science Indicators on Diskette, 2010, Thomson Reuters Co. ◦ 2.EI Papers : Compendex, Oct., Week 3, 2010, Elsevier Inc., USA ◦ 3.US Patent Approvals : US Patent and Trademark Office ◦ 4. Taiwan Invention and Patent Approvals : MOEA's Intellectual Property Office ◦ 5. Volume of Technology Trade : MOEA's Industrial Statistics Report.



2. State of Taiwan's Scientific Research and Output (5/10) -- Considerable Success in Patents

No. of US Patent Approvals among Major Nations



- Taiwan has ranked fifth in US patent approvals since 2007, and is third among East Asian nations behind only Japan and South Korea.
- Taiwan has had enormous success in international invention competitions (88% of Taiwan's entries won awards at the 2009 iENA Nuremberg), and submits a large number of patent applications in the US.

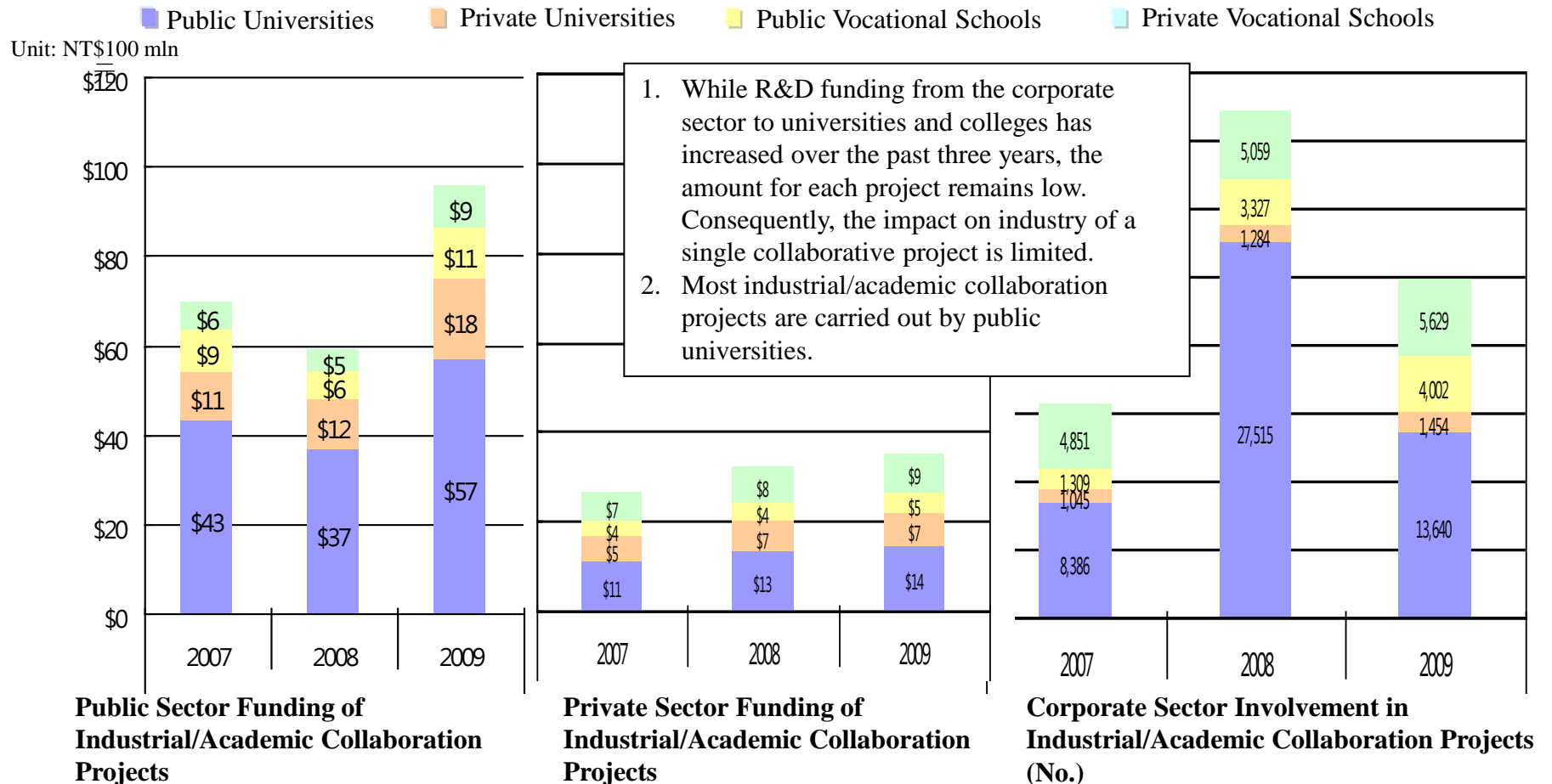
Source: National Science Council's 2010 S&T Statistical Highlights



2. State of Taiwan's Scientific Research and Output (6/10)

-- Collaboration between the Industrial and Academic Sectors

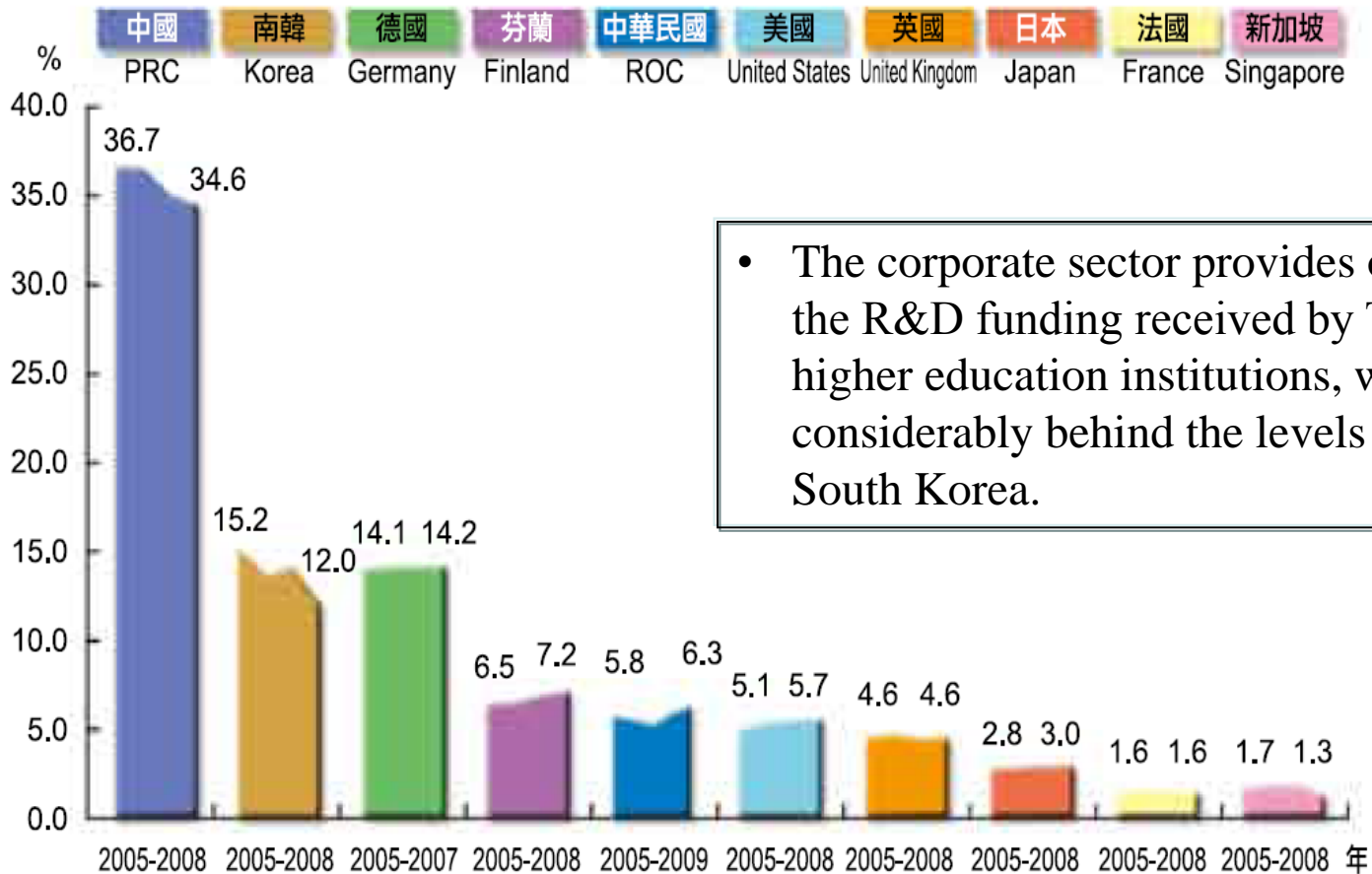
Industry has minimal involvement in industrial/academic collaboration
Impact on industry of industrial/academic collaboration is extremely limited



Source: 2010 Ministry of Education, 30th STAG Board Meeting

2. State of Taiwan's Scientific Research and Output (7/10)

-- Ratio of Corporate Funding to Total Amount of Higher Education R&D Funding



- The corporate sector provides only 6.3% of the R&D funding received by Taiwan's higher education institutions, which is considerably behind the levels in China and South Korea.

Source: National Science Council's 2010 S&T Statistical Highlights

2. State of Taiwan's Scientific Research and Output (8/10)

--Commercialization Value of University Scientific Research (2009)

Category (No. of Schools)	Indicator 1 : IP Income			Indicator 2 : No. of Start-ups		
	Total IP Income (NT\$100 mln)	Gov't- subsidized R&D Funding (NT\$100 mln)	Total IP Income as a Percentage of R&D Funding (%)	Start-ups Receiving Technology Transfers in Incubators (No.)	Start-ups in Incubators without Technology Transfers (No.)	Start-ups Receiving Technology Transfers not in Incubators (No.)
Public Universities (36)	3.00	267.97	1.02%	17	286	22
Total (165)	4.74	393.44	1.04%	62	712	66
Reference Indicator: The US in 2008	IP Income Constitutes 6.7% of Total R&D Funding			American Universities Nurtured 595 Start-ups in 2008 with Licensed Technology		

Source: MOE data assessing the performance of collaboration between the industrial and academic sectors; Association of University Technology Managers' 2008 Report on Technology Licensing Activities



2. State of Taiwan's Scientific Research and Output (9/10)

-- In Summary ...

1. Increase in Commercialization Efficiency Required

•R&D funding as a percentage of GDP has reached international standards and Taiwan exhibits strength in the number of papers published and patents obtained. This, however, isn't substantively reflected economically (technology upgrading and creation of value). ◦

State of Scientific Research/Output

Major gap in the expected result of research results and commercialization.

→ **Do performance indicators need to be adjusted?**

→ **Is the environment to achieve such still insufficient?**

2. Strengthened Link Required between Scientific Research & Industry

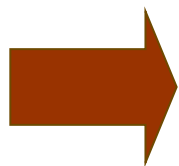
•70% of Taiwan's PhD holders are in academia. Taiwan exhibits excellence in foresight research. However, the linkage between S&T research results and commercialization value remains extremely low.



2. State of Taiwan's Scientific Research and Output (10/10) -- In Other Words

Several blind spots seemingly exist in Taiwan's scientific research:

1. Research is **unable to move from the “point” to “the solution plane.”**
2. Topics overly focus on the “Me too” aspect, rather than **“differentiation innovation.”**
3. Mentality emphasizes “Technology Push” and only rarely considers **“Demand Pull”**



Lack of Entrepreneurial Thinking



3. Commercialization and Value Creation of University Research (1/9)

Bank of Boston 1999 Research Report 《MIT : Impact of Innovation》

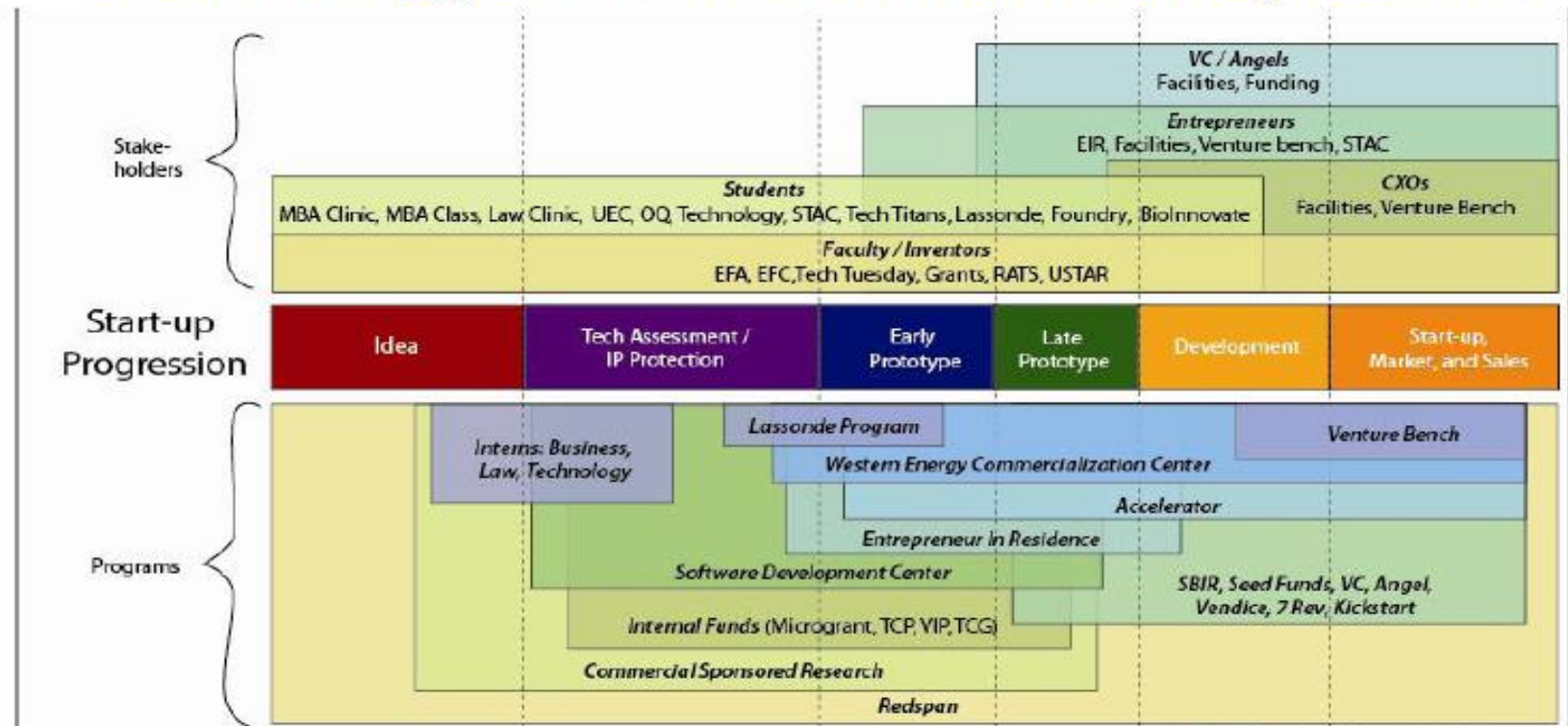
- The report indicated that graduates and instructors of MIT since 1990 had established an average of 150 start-ups annually.
- 60-70% of companies in the Silicon Valley were established by students or instructors from Stanford University. From 1986 to 1996, at least half of the Silicon Valley's income was contributed by start-ups created by Stanford students or instructors.
- Over the past decade, an average 600,000 start-ups have been created annually. Since the 20th century, while companies in the Fortune 500 have eliminated five million jobs, 34 million new jobs have been created. In other words, start-ups and entrepreneurs are responsible for creating over 70% of new jobs.
- Start-ups are responsible for 67% of inventions in the US.



3. Commercialization and Value Creation of University Research (2/9)

Method of Promotion by American Universities

Technology Commercialization Spectrum



3. Commercialization and Value Creation of University Research (3/9)

Method of Promotion by American Universities

■ Tool Kit

1. Mentor
2. Catalyst Funding
3. Incubation
4. Venture Capital

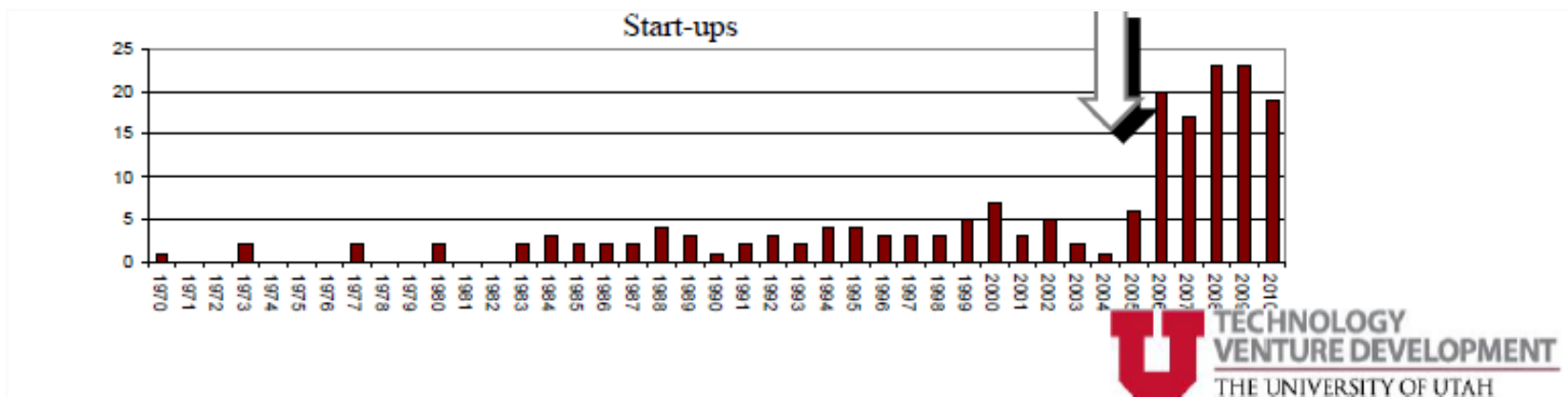
- **Students:**
 - Few students will go into academia
 - Students desire practical training for their careers
 - Students provide the “**market pull**”
- **Faculty:**
 - Faculty should provide training in, e.g.:
 - Market research (lecture and lab)
 - MBA essentials – management, communication, finance
 - Intellectual property and legal essentials
 - Drug and device regulatory approval process
 - Innovation addressing **global needs**



3. Commercialization and Value Creation of University Research (4/9)

Method of Promotion by American Universities

- Concrete Results:
 - Over 1500 students participating in programs
 - 19 new companies formed in 2010
 - **University of Utah was No.1 in start-ups based on AUTM Survey of university technology in 2010**
 - Utah ranks first in revenue generated per research dollar for major research universities



3. Commercialization and Value Creation of University Research (5/9)

Method of Promotion by American Universities

- Concrete Results:
 - Economic Impact of University of Utah Startups
 - **Utah ranked No.1 in Best for Business by *Forbes* in 2010**

	Direct Employment	Total Employment	Total Employment Income	State and Local Tax Contribution
FY 09	5,700	15,600	\$747 M	\$76 M
FY 10	6,800	19,000	\$905 M	\$92 M
to Dec FY 11	7,200	20,000	\$947 M	\$96 M

Source: 2011 Bureau of Economic and Business Research

3. Commercialization and Value Creation of University Research (6/9)

Efforts of the US Government

- NSF announced the I-Corps on July 28, 2011
- To help develop scientific and engineering discoveries into useful technologies, products and processes
- “... to bring innovators, mentors and entrepreneurs together in a meaningful way to create economic and social impact...”

***From Empowering the Nation through Discovery and Innovation: NSF Strategic Plan for Fiscal Years 2011-2016**

Press Release 11-153
I-Corps: To Strengthen the Impact of Scientific Discoveries



[View Video](#)
NSF Director Subra Suresh announces the NSF Innovation Corps (I-Corps) program. [Credit and Larger Version](#)



[View Video](#)
White House Office of Science and Technology Policy Director John P. Holdren. [Credit and Larger Version](#)



July 28, 2011

Today, the National Science Foundation (NSF) announced a new effort to help develop scientific and engineering discoveries into useful technologies, products and processes.

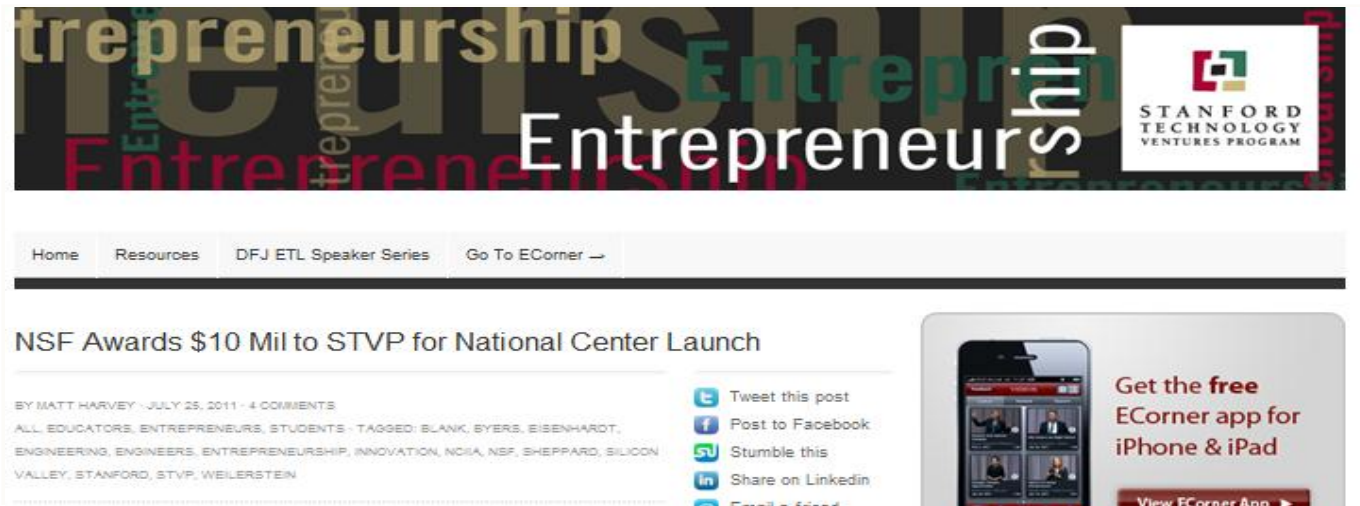
The NSF Innovation Corps (I-Corps) program, a public-private partnership, will connect NSF-funded scientific research with the technological, entrepreneurial and business communities to help create a stronger national ecosystem for innovation that couples scientific discovery with technology development and societal needs.



3. Commercialization and Value Creation of University Research (7/9)

Efforts of the US Government

■ NSF Awards \$10 Million to STVP for National Center Launch -- July 29, 2011

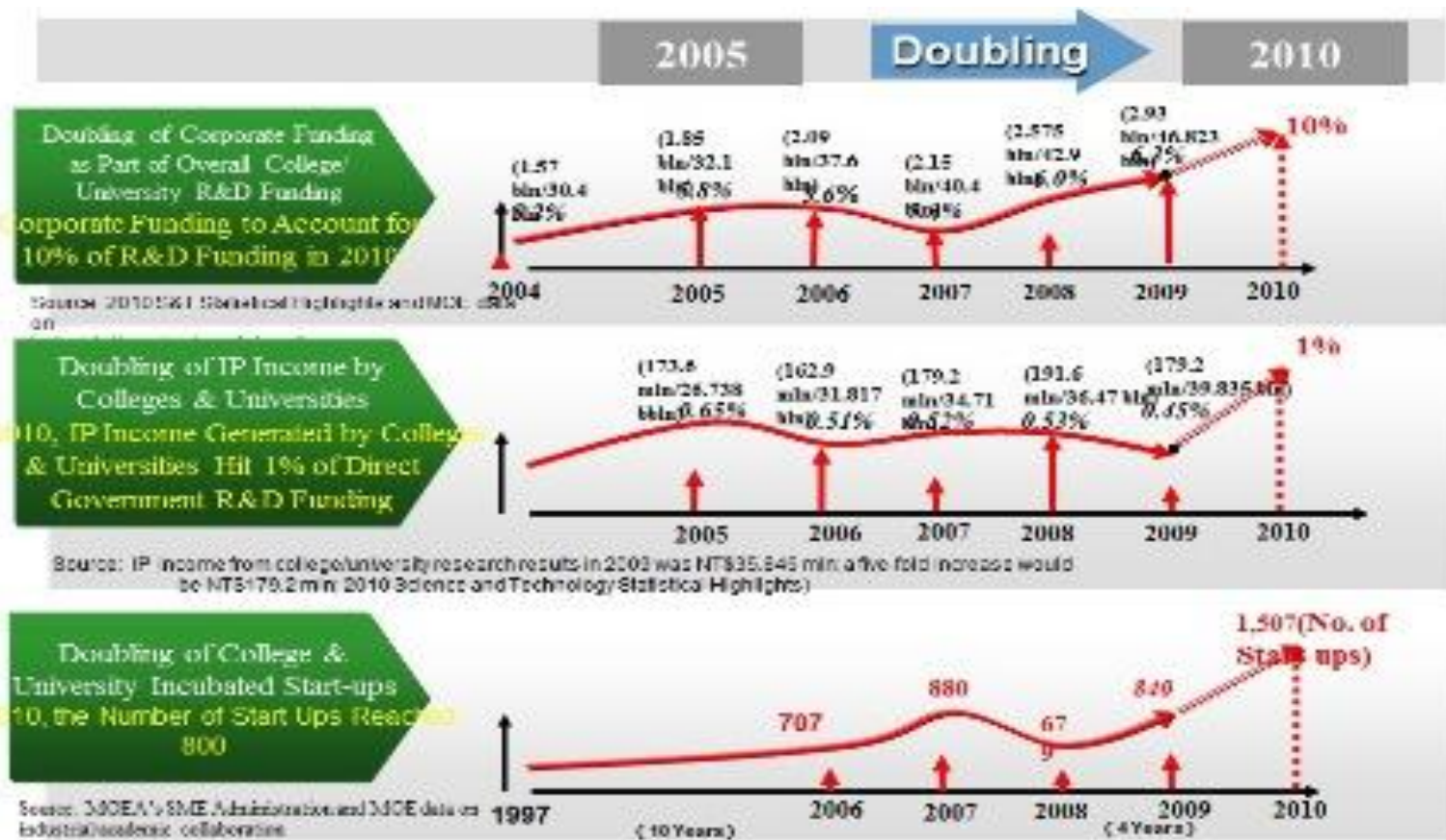


■ “The hope is to link innovation-savvy students with revolutionary technology companies, and influence significant job creation.”



3. Commercialization and Value Creation of University Research (8/9)

@ The Executive Yuan's Industrial Manpower Plan promotes the collaboration of the industrial and academic sectors in value added projects to realize commercialization of research results. The policy objective had yet to be achieved in 2010.



3. Commercialization and Value Creation of University Research (9/9) --Results of Providing Financial Assistance to Create Start-ups under the U-START Project

- The MOE has promoted the U-Start Program since 2009, providing financial assistance to 81 colleges and universities in Taiwan to found 41 start-up teams. To date, 158 start-ups, or 38%, are still in operation.
- In 2010, domestic incubators fostered the creation of 840 start-ups, and instigators under the U-Start Program accounted for 19% of those firms.

Category (No. of Schools)	U-START Financing for No. of Start-up Teams			U-START No. of Start-ups (Still in Operation)			Success Rate (b/a)
	2009	2010	Sub-total a	2009	2010	Sub-total b	
Public Universities (36)	105(33%)	37(37%)	142(34%)	24(27%)	27(39%)	51(32%)	36%
Private Universities (36)	70(22%)	10(10%)	80(19%)	23(26%)	8(11%)	31(20%)	39%
Public Vocational Colleges(20)	37(12%)	14(14%)	51(12%)	17(19%)	10(14%)	27(17%)	53%
Private Vocational Colleges(73)	103(33%)	39(39%)	142(34%)	24(27%)	25(36%)	49(31%)	35%
Total(165)	315(100%)	100(100%)	415(100%)	88(100%)	70(100%)	158(100%)	38%



4. Challenges Faced by Taiwan in the Commercialization of University Scientific Research (1/2)

1. Impacted by the traditional educational philosophy over thousands of years in which “a good scholar can become an official,” some (including university administrators) are skeptical or cool to university students creating start-ups.
 - Insufficient enticements for universities and instructors to participate in the commercialization of knowledge and research results
 - Campuses don't promote an a culture conducive to entrepreneurship and start-ups

Academic Scholarship is **Evolving !!**

Traditional Model

If you get grants, publish in top journals or win awards, you will be respected

Evolving Model

If your scholarship has a positive impact on society, everyone will **respect you**



4. Challenges Faced by Taiwan in the Commercialization of University Research (2/2)

2. Scientific research teams require effective measures to reduce obstacles to start-ups and to encourage start-ups, including a mentor system, catalyst funding, incubation, and venture capital.
 - Dedicated and profession venture capital team

1. Public universities only emphasize industrial/academic cooperation and technology transfers. They lack the ability and a dedicated organization to incubate and provide guidance to start-ups.
- 2. Universities lack the ability to circulate and make the best use of their patents. For instance, create value with patent portfolio.**
3. IP creation requires a greater strategic effort. Universities lack a mindset that emphasizes the creation of industrial value.

Source: Draft Program for the Promotion of Invention Patent Industrialization (2010)



5. Recommendations and Conclusions (1/3)

-- Policy Recommendations (Strategic)

1. Universities must shoulder the responsibility of initiating technology foresight and industrial innovation. Universities should play a pivotal role in using their strengths in R&D to build Taiwan into a innovation-driven industrial powerhouse.
2. The government should strategically assist universities in becoming the cradle for industrial foresight and innovation, helping universities become a **platform for the creation of industrial value.**



5. Recommendations and Conclusions (2/3)

--Policy Recommendations (Execution)

1. Aggressively promote university spin-off/business start-up programs to maximize the use of university research discoveries
 - It is recommended to integrate the business start-up and incubation projects of various government agencies, thereby providing greater assistance in the incubation of start-ups resulting from university research results. The private sector and industrial sector should be effectively introduced into campuses.
 - Universities should establish bodies dedicated to creating a business start-up culture on campuses and helping to generate momentum to establish start-ups.
 - Promotion of the Program for the Promotion of Invention Patent Industrialization should be expanded to university campuses.



5. Recommendations and Conclusions (3/3)

-- Policy Recommendations (Execution)

2. The commercialization of research results and the value generated by these discoveries should serve as key performance indicators in the assessment of university scientific research.
 - Strategies, organization, and results of commercialization and value creation of university scientific research achievements should be included in the academic appraisal mechanism.
 - Project-based R&D results should meet the aforementioned indicators and should emphasize the development of essential IP.
 - Nation-wide projects or mission-based research projects should be included in industrial value creation indicators (this should also be emphasized among projects carried out by institutions).
 - NT\$50 billion should be invested over a five-year period in establishing top R&D centers and emphasis should be placed on attracting private and international R&D resources.



Thank you. We look forward to
hearing your suggestions!

