



# Taiwan's Evolving Innovation Systems in the Context of Global Economy

**US-ATMC**  
**Stanford University**  
**Oct. 18, 2007**



**新竹科學工業園區**  
**Hsinchu Science Park**  
**Taiwan**



**Dr. Sean S. H. Wang**  
**President**  
**ITRI International**  
**(a subsidiary of ITRI)**

工業技術研究院北美公司總經理王韶華



# Outline

## ■ Fast Facts

### ■ Global Value Chain and Taiwan's Position

- Opportunities for New Players
- Taiwan: the de facto of Manufacture Excellence
- Taiwan: Strengths and Competitiveness Advantages

### ■ Taiwan's Innovation System: *Recap of a Success Story*

- Framework of the Innovation System
- TDP (Technology Development Program)
- ITRI (Industrial Technology Research Institute)
- HSIP (Hsinchu Science-Based Industrial Park)

### ■ Taiwan's Innovation System: *Evolving*

- Responding to Challenges
- Capturing New Opportunities
- Outlook

### ■ Summary





# = Formosa



The Grand Hotel



Palace Museum



Ferris Wheel



Taipei 101



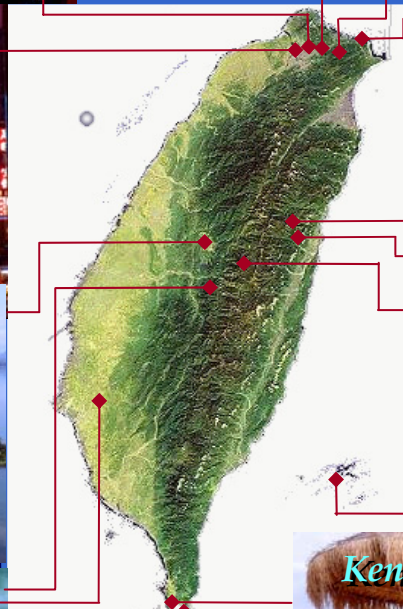
Yeliu



Basalt at Penghu



Night Market



Tunnel of Nine Turns



Eternal Spring Shrine



Traditional House



Sun Moon Lake



Monte Jade



Beehive Rockets Festival



Tea Plantation



Sailing Boat Rock



Kenting Beach



Tao Boat Festival

Pictures courtesy of Tourism Bureau, Ministry of Transportation & Communications , R.O.C.

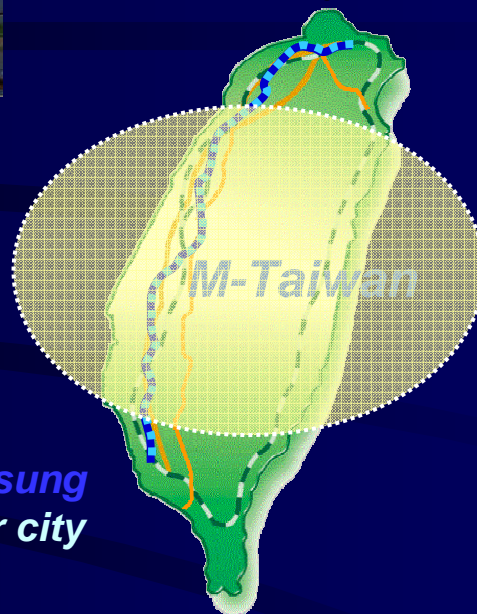




# Well-Developed and Advanced Infrastructure



*Taipei  
Wi-Fi City*



*Kaohsiung  
Cyber city*

*Taipei  
MRT*



- **High speed rail make Taiwan a “one-day” metropolitan** (max speed of 300 km/hr)
- **M-Taiwan:**
  - A four year program launched in December 2005 with a total budget of US\$212 mm.
  - Expected to stimulate investment of US\$630 mm on WiMAX network infrastructure.
  - In addition to traditional telecommunication operators, fixed-line communication operators, mobile communication operators, PHS operators and other new entries in this field are all involved in building Taiwan’s WiMAX network.



## Fast Facts

**Population:** 22.9 million (July 2007 est.)  
**Mobile Phone Subscription:** 23.2 million (Dec. 2006; 105% penetration)

**GDP** \$364.4 billion (2006)  
**GDP per capita** \$16,030 (2006)  
**GDP composition by sector:** Agriculture: 1.5% (2006)  
Manufacturing: 25.2%  
Services: 73.3%

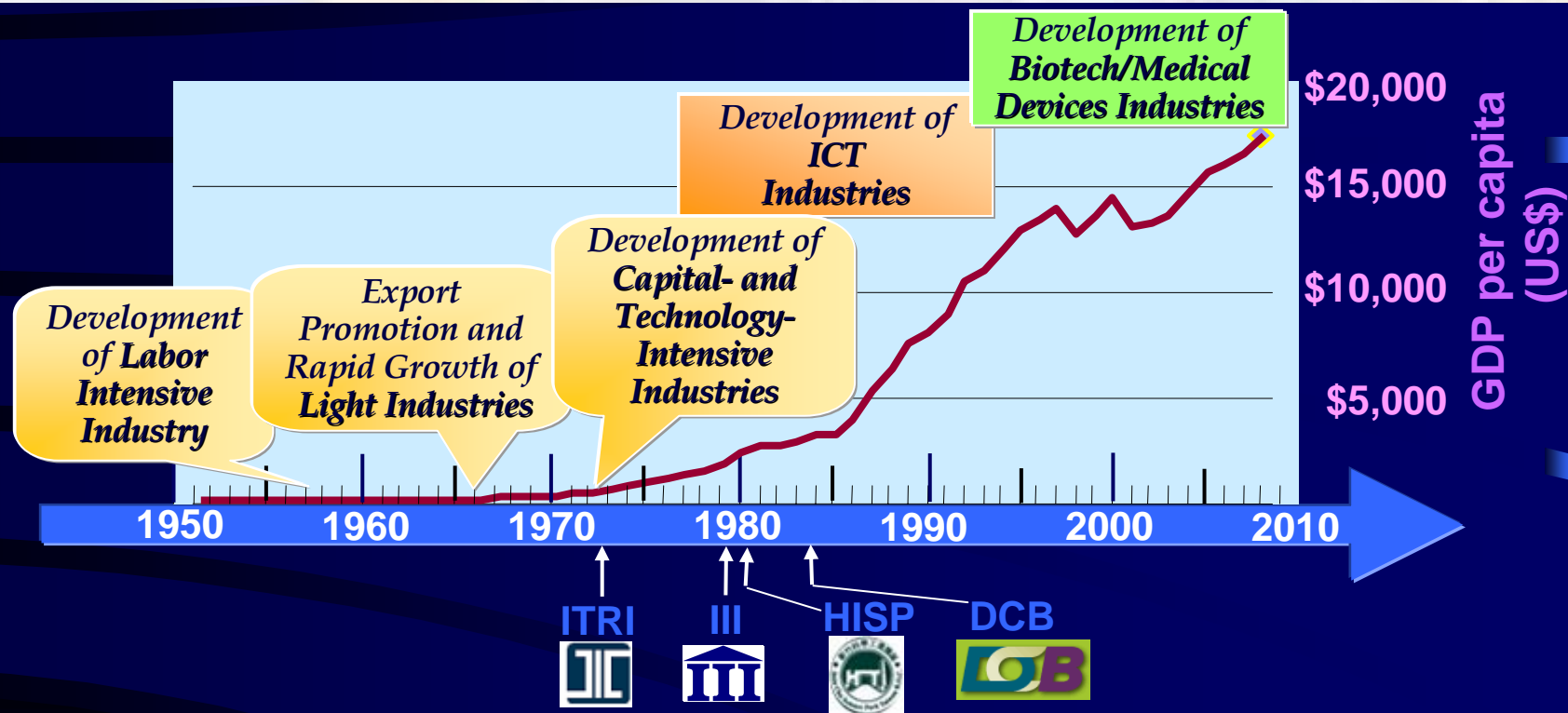
**Foreign Exchange Reserve:** US\$263 billion (Sept. 2007)  
**External Debt:** US\$84.6 billion (March 2007)

**Imports - partners:** Japan 23%, China 11.9%, US 10.9%, South Korea 7.2%, Saudi Arabia 4.9% (2006 est.)  
**Exports - partners:** China 22.5%, Hong Kong 15.7%, US 15%, Japan 7.3% (2006 est.)

*GDP data Source: The Directorate General of Budget, Accounting and Statistics (DGBAS) of Executive Yuan, Taiwan (R.O.C.)*



# General Background of Industrial Development



- Taiwan's Industry is mainly consisted of SMEs with limited R&D resources.
- Established non-profit research institutes to promote industrial R&D and to develop industrial technology
- Established science-based parks for promoting development of high-tech industry

ITRI: Industrial Technology Research Institute  
III: Institute for Information Industry

DCB: Development Center of Biotechnology  
HSIP: Hsinchu Science-Based Industrial Park

Data Source: The Directorate General of Budget, Accounting and Statistics (DGBAS) of Executive Yuan, Taiwan (R.O.C.)



# Competitiveness Ranking

		US	SG	CH	CN	DE	TW	JP	IN	KR
IMD	2007 Overall Competitiveness	1	2	6	15	16	18	24	27	29
	2006 Overall Competitiveness	1	3	8	18	25	17	16	27	32

Source: World Competitiveness Yearbook 2007, IMD

		CH	SG	US	JP	DE	TW	KR	IN	CN
WEF	Global Competitiveness	1	5	6	7	8	13	24	43	54
	Business Competitiveness	4	11	1	9	2	21	25	27	64
	Innovation Factor	2	15	4	1	3	9	20	26	57

Source: The Global Competitiveness Report 2006-2007, World Economic Forum



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# ICT Industry Opens for New Players

## The Disintegration of the IT Industry

	1960~1980	1980~1990	1990~present
Equipment	IBM DEC ...	Applied Materials...	
Materials		...	
Components		Intel, Micron, Quantum...	
Product design		IBM, Compaq, Dell,...	
Assembly		IBM, Compaq...	Solectron...
Operating system		Microsoft	
Application software		WordPerfect, Borland, Microsoft...	
Sales and distribution		CompUSA...	Dell...
Field service		Independent contractors	

■ Open doors for new players...

Reference: "The Innovator's Solution: Creating and Sustaining Successful Growth,"  
by C. M. Christensen, M. E. Raynor



# ***“Why Taiwan Matters”***

**– Business Week (May 16, 2005)**

*“The global economy couldn’t function without it...”*

## **Business Week**

*“Taiwanese companies, from chip foundry TSMC to laptop maker Quanta, manufacture thousands of items essential to the global economy. Most appears under someone else’s name  
—and most are made in mainland China.”*

***Business Week (May 16, 2005)***



	Rank	Share	Revenue*
Foundry	#1	70%	US\$89 bn
NB, PC	#1	72%	US\$22 bn
LCD monitors	#1	70%	US\$14 bn
PDA	#1	70%	US\$1.8 bn
DSC	#2	34%	US\$2.0 bn
Servers	#2	33%	US\$1.8 bn

\*Revenue data of 2004

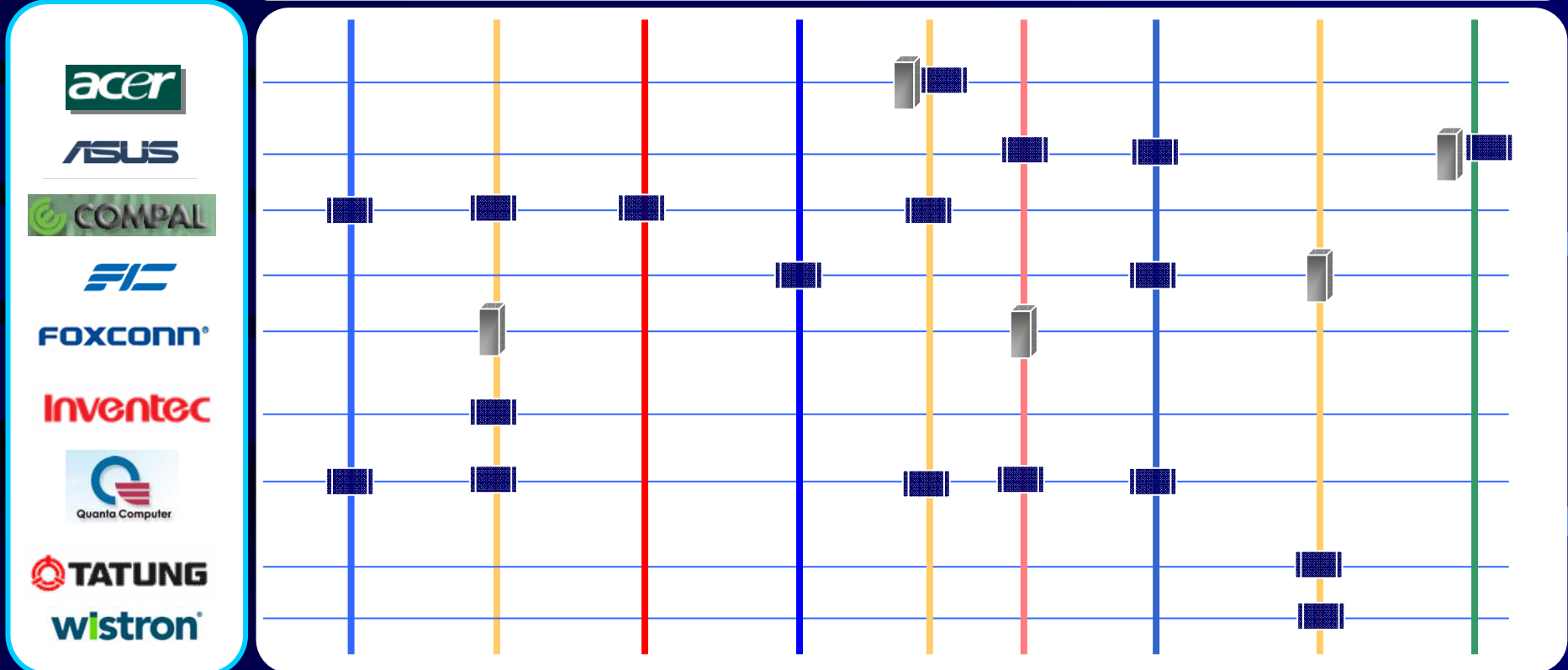
NB: notebook, DSC: digital still camera



# The *de facto* Manufacture Excellence

*Example: As Major Laptop and Desktop Suppliers*

Suppliers



□ Laptop


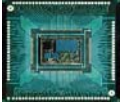


□ Desktop





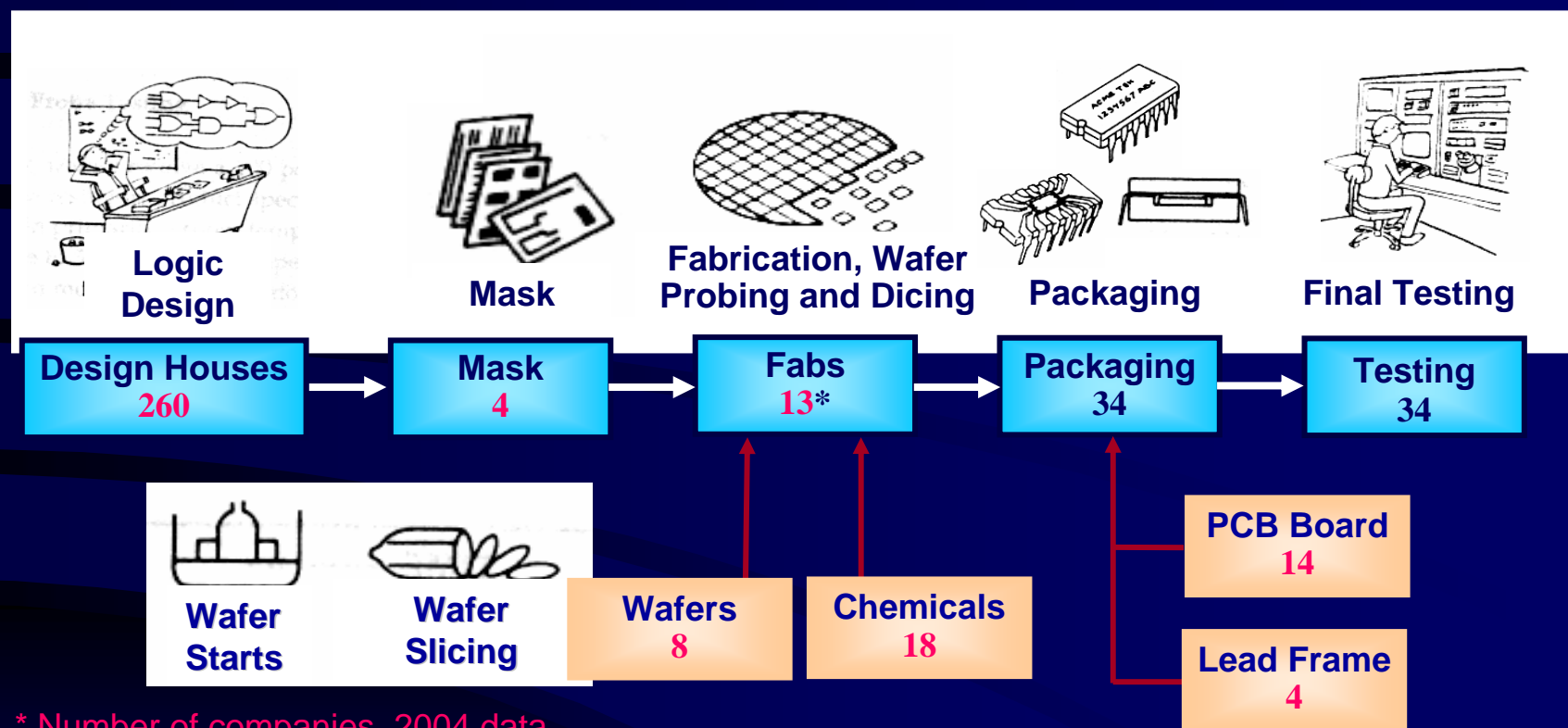
# Fast Growing ICT Sectors in Taiwan

## 2006 Revenue and Growth Rate

	<b>IT</b> <b>US\$85.9 bn*</b> <b>11.6%</b>	<ul style="list-style-type: none"><li>• <b>IT Hardware:</b> laptop, desktop, server, DSC, LCD monitor, CDT monitor, projector, PCB, etc.</li><li>• <b>Network &amp; Communications</b></li><li>• <b>Software Industry</b></li></ul>
	<b>IC</b> <b>US\$42.8 bn*</b> <b>24.6%</b>	<ul style="list-style-type: none"><li>• <b>IC:</b> IC design, manufacture, assembly and testing</li><li>• <b>IC related applications:</b> memory, logic components, system chips, communication, display, multimedia and IA.</li></ul>
	<b>Opto-Elec</b> <b>US\$39.1 bn*</b> <b>30.8%</b>	<ul style="list-style-type: none"><li>• <b>Panel :</b> PDP, TFT LCD, TN/STN, OLED</li><li>• <b>Key Component:</b> : Glass, Color Filter, Backlight, Driver IC, Polarizer</li></ul>
	<b>Telecom</b> <b>US\$21.5 bn*</b> <b>41.5%</b>	<ul style="list-style-type: none"><li>• <b>Broadband Networking:</b> Optical communication industry, LAN products, broadband access equipment and IP applications.</li><li>• <b>Wireless Communications:</b> End user equipment, WLAN, WMAN, Personal Area Network, Data transmission devices, GPS</li></ul>



# IC Clusters



- *Highly integrated value chain with synergy of cluster*
- *Agile and fast-responding supply network*
- *Well developed supporting services*

Source: :ITRI (March 2005)



# TFT-LCD Clusters

## Hsinchu



## Taichung



## Yunling



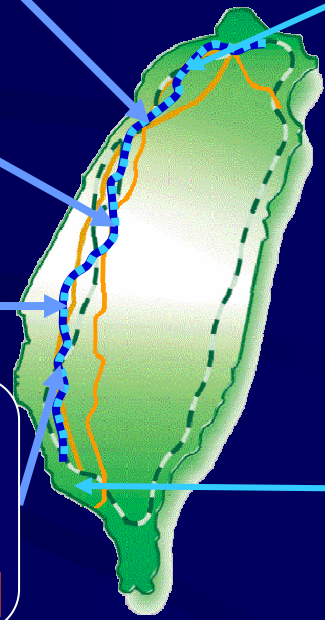
## Tainan



## Taoyuan



## Kaohsiung



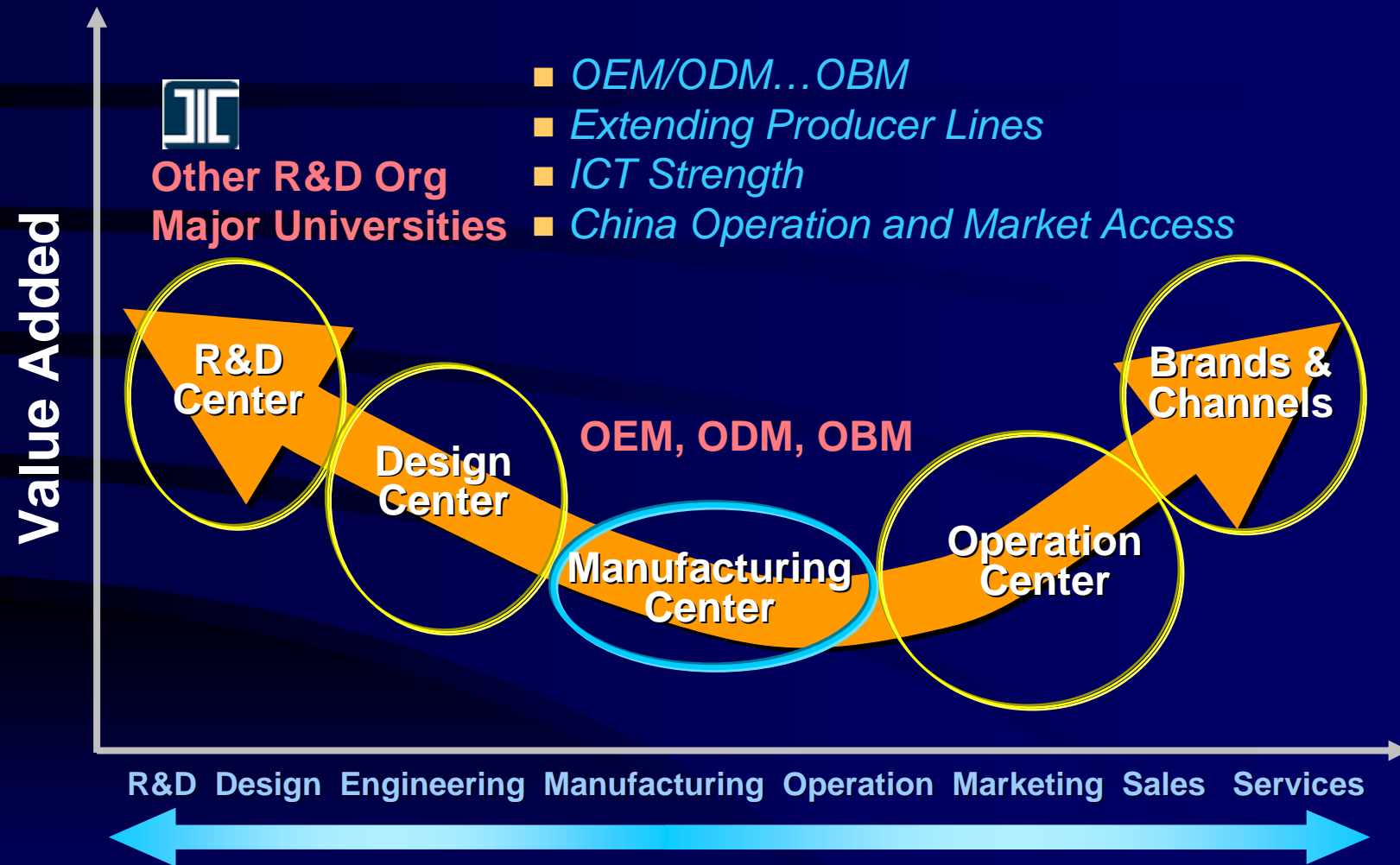
- Flagship companies and incentives at some Science parks to attract a cluster
- Short deliver time among clusters with reliable services
- Supply of high quality talents from regional universities and research institutes

Source: ITRI (June 2006)





# Strengths and Competitiveness Advantages



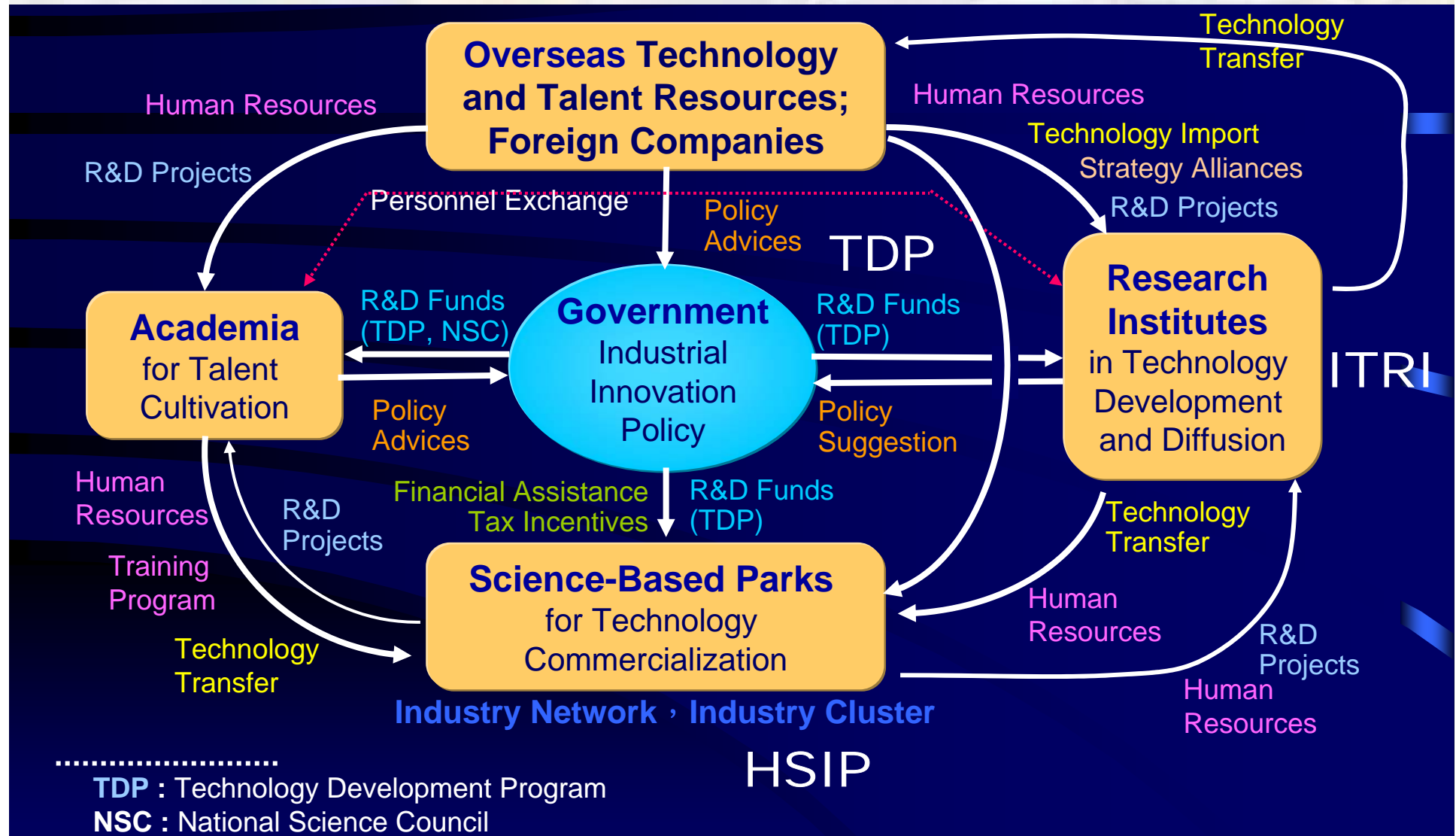


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# Framework of Innovation System

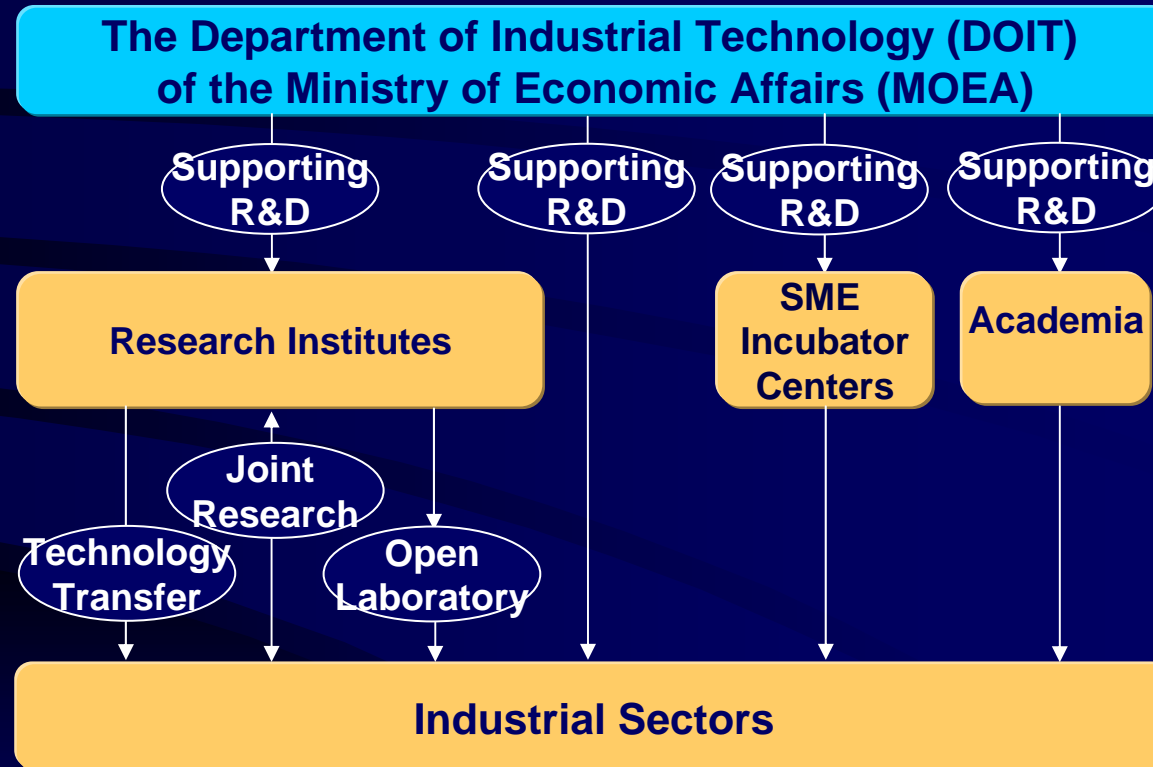






# Technology Development Program

*Established in 1979 by the MOEA  
drawing on an annual budget to support technology R&D*





# ITRI Overview

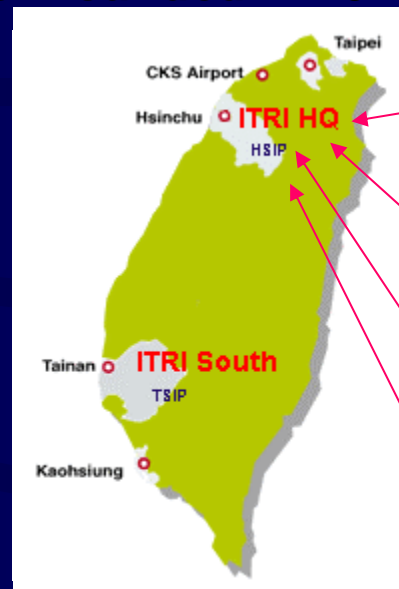
*A non-profit R&D institution founded in 1973*

- To create economic value through technology R&D
- To spearhead the development of emerging high-tech industry
- To enhance the competitiveness of industries in the global market



*From Follower to Pioneer*

**ITRI Innovation Plaza**



- ITRI International (San Jose, CA, USA)
- Europe Offices (Berlin and Moscow)
- Japan Office (Tokyo)
- ITIC (VC subsidiary)

**Manpower:** ~ 5,800

**Revenue:** US\$540 MM (2006; 52% from government funded projects)

Technology R&D	52.0%
Ind. Tech Services	41.0%
IP Business & New Ventures	6.6%
Others	0.4%

**ITRI alumni:** 17,304 (from 1973-2004; 81% in industry)

***For every dollars Invested in ITRI, \$10.77 returned to the society at large\****

\* P.Y. Chu, Chiao-Tung University, 2003



# ITRI Research Scope and Organization

*R&D carried out in 6 core labs and 6 focus centers,  
with linkage centers for other functions*

## Core Labs

Electronics and Optoelectronics Research Laboratories  
Information and Communications Research Laboratories  
Mechanical and Systems Research Laboratories  
Material and Chemical Research Laboratories  
Energy and Environment Research Laboratories  
Biomedical Engineering Research Laboratories

## Focus Centers

Display Technology Center  
SoC Technology Center  
Photovoltaics Technology Center  
Medical Electronics and Device Technology Center  
RFID Technology Center  
Technology Center for Service Industries

## Linkage Centers

Nanotechnology Research Center  
Technology Transfer and Service Center  
Industrial Knowledge and Economics Center (IEK)  
Creativity Laboratory  
ITRI College

Information and  
Communications  
Technologies

Advanced  
Manufacturing  
and Systems

Nanotechnology,  
Material and  
Chemical

Energy and  
Environmental

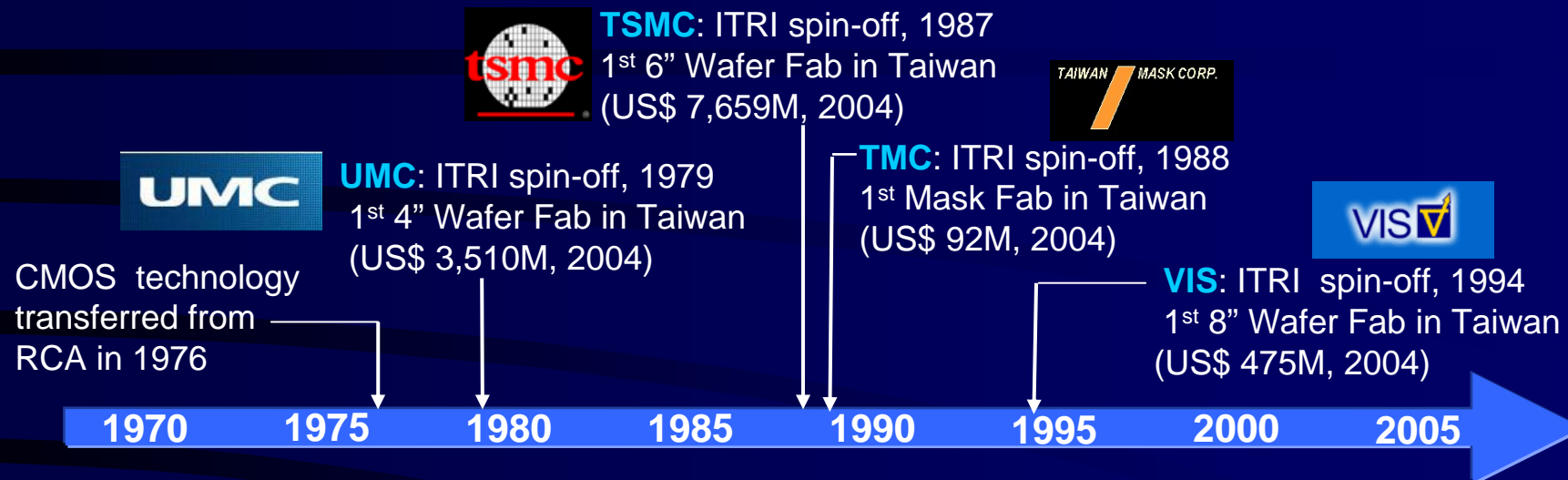
Biomedical  
Technology





# ITRI's Major Spin-Offs and Open Lab

## Major spin-offs including UMC and TSMC



## Open Lab:

**A conducive environment for industries to access ITRI R&D resources**

- Joint R&D collaboration programs for existing companies
- Incubation of high-tech startups
- As of Dec. 2004, 214 projects completed, 130 new companies formed with total capitalization of US\$1.43 billion



# Overview of Science Parks in Taiwan

**HSIP: Established in 1980 to create an environment in Taiwan conducive to high-tech research and development, production, work, life and entertainment.**

## Incentives

- 5 Years Income Tax Exemption
- Protection of Investors' Rights
- No Import Duty & Commodity Tax
- Low Interest Rate Loans
- R/D Matching Grants
- Automation/R&D/Training Expenditure to be Credited Against Income Tax

## One-stop Service

- Land Administration
- On-job Training
- Investment Services
- Labor Management
- Business Services
- Construction
- Medical Services
- Information Network
- Customs
- Truck Depot
- Environmental Protection
- Security

## HSIP and Extensions

Location	Starting Year	Size (hector)
Main Campus	1980	632
Chunan	1999	141
Longtan	2004	198
Tungluo	2005	350
Biomedical Park	2005	38
Yilan	2005	600
Total size		1959



## 2004 Data:

**No. of Companies:** 384 (164 IC, 58 PC, 52 telecom, 61 opto-electronics, 28 biotech, 21 precision machinery)

**Employment:** 115,477 (1% Ph.D., 19% M.S)

**Revenue:** US\$32.6 bn

**Paid-In Capital:** US\$32.6 bn (88% private, 2% government, 10% foreign)

**HSIP is an important measure for promoting development of high-tech industry.**

Source: Administration of HSIP (May 2005)

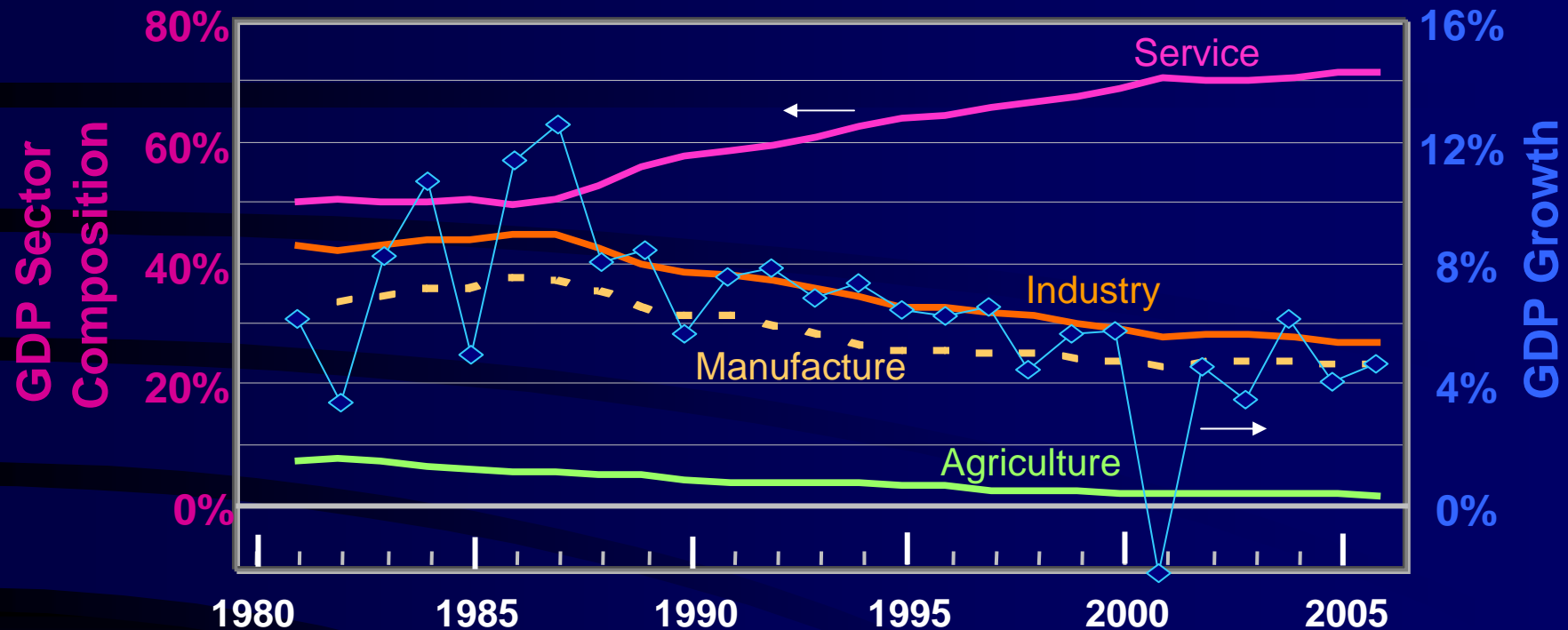


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# GDP Growth and Sector Composition



- *Since 1987, the industry sector has been growing slower than the service sector mainly because the appreciation of NT\$ and the off-shoring of manufacture.*
- *GDP growth also became slower as the share of the industry sector dropped.*

Data Source: The Directorate General of Budget, Accounting and Statistics (DGBAS) of Executive Yuan, Taiwan (R.O.C.)



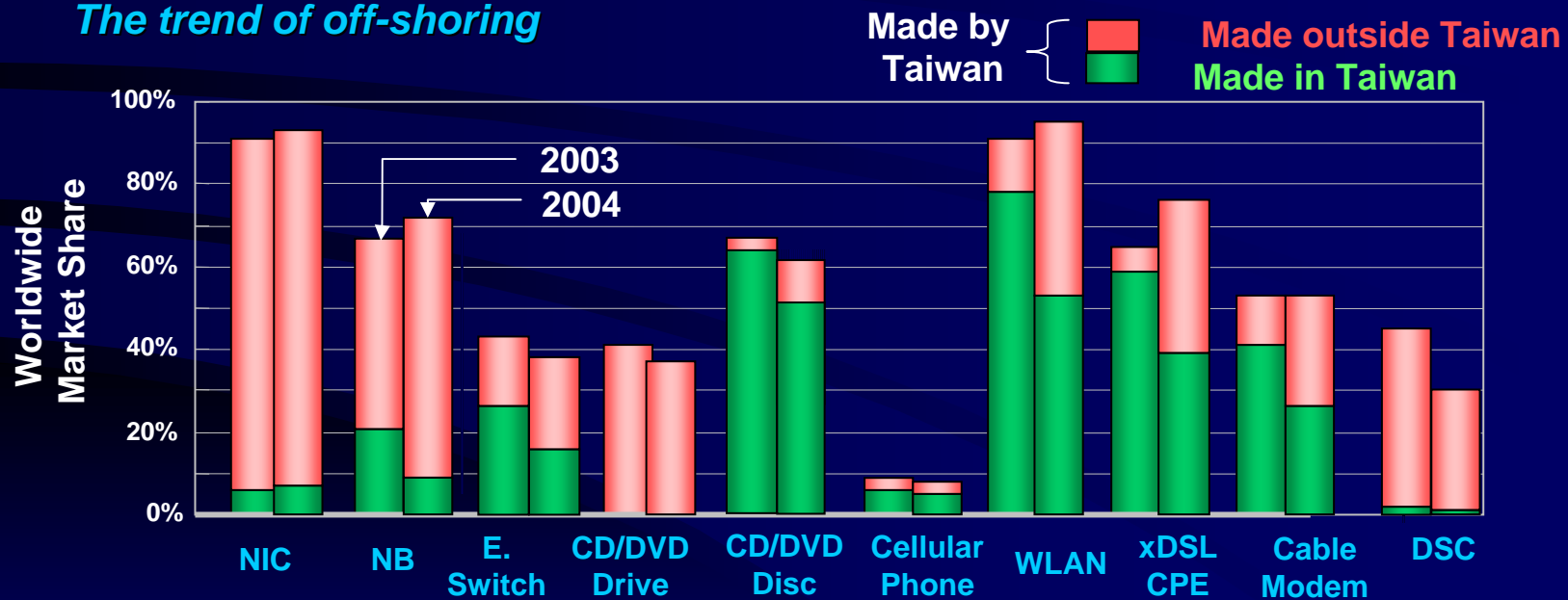


# Working Fine *but* Facing New Challenges

*Unique innovation system in Taiwan results in competitive high-tech Industries but ...*

- *High-tech turning to low margins*
- *High-tech driving little economy development (off-shoring..)*
- *New barriers arising from regional free-trade agreement*

*The trend of off-shoring*

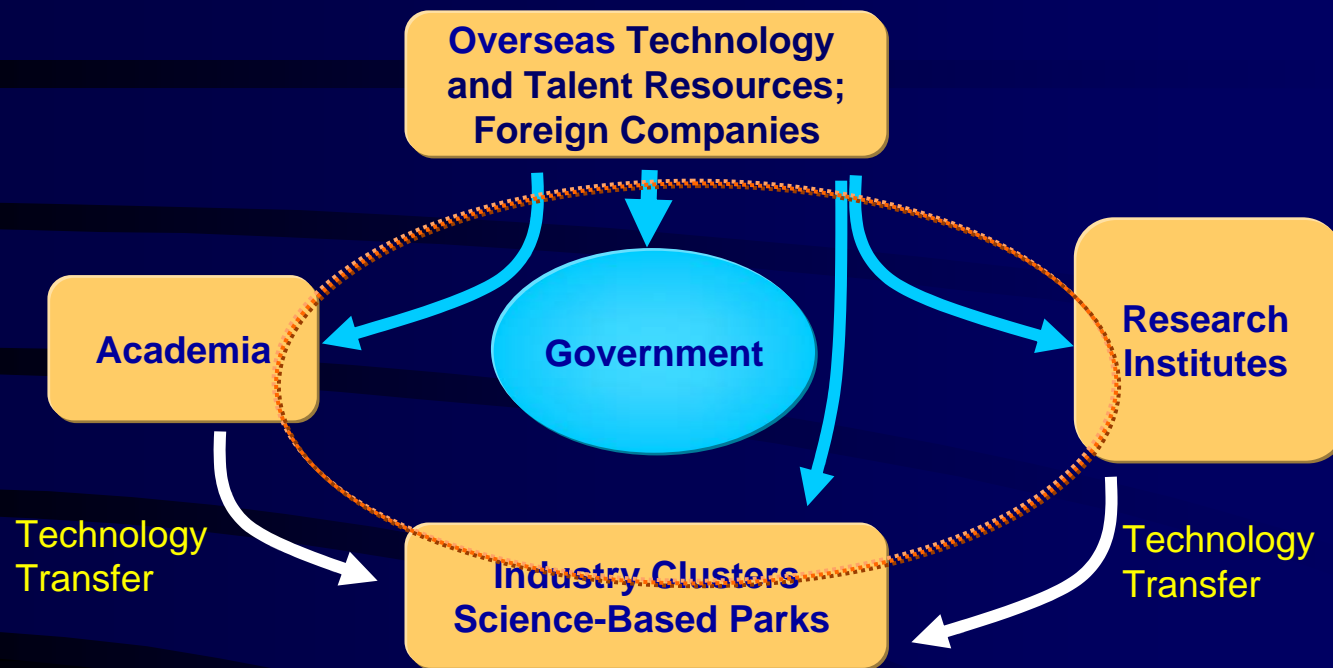


■ *Over 60% IT Production in China is contributed by Taiwanese firms*

Source: ITRI (May 2005)



# Strengthen the Innovation System

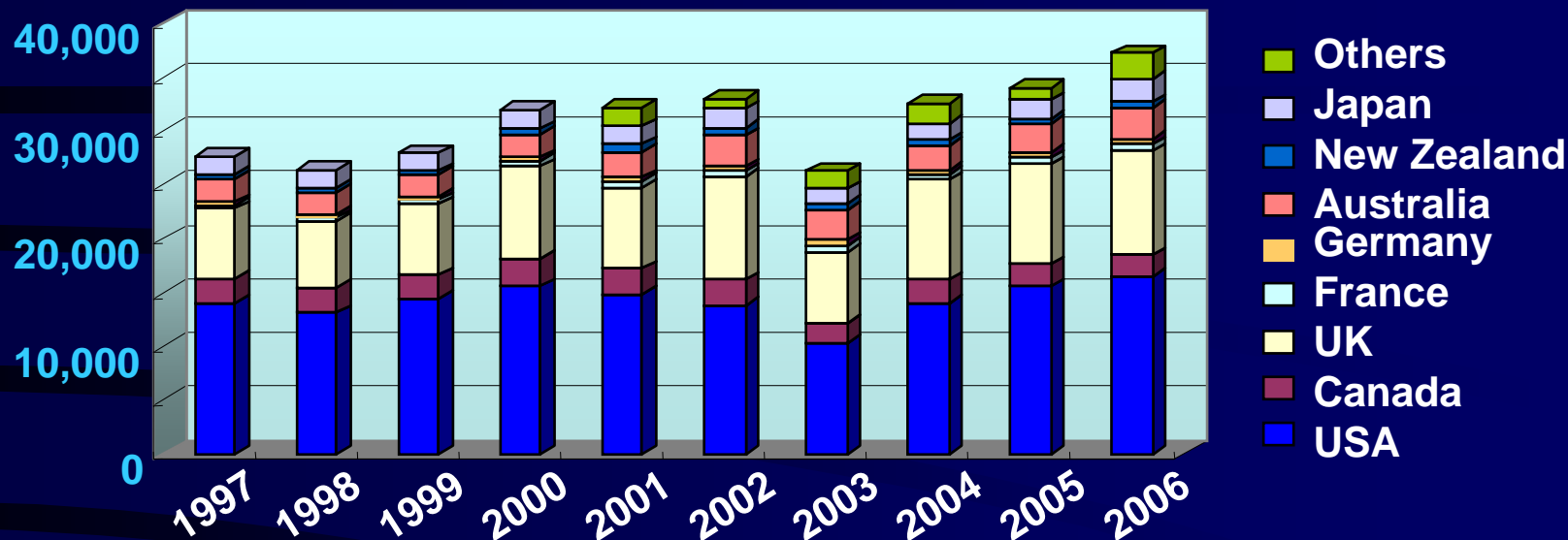


- Better efficiency in technology transfer
- New measures in government's policies to utilize global resources
- Greater incentives for collaboration or alliances among industrial, academic and research sectors



# Promoting Study/Research Abroad and Attracting Returnees/Foreign Students

Number of Visa issued to Taiwanese Students



- 菁英留學計劃 “Elite Program” started in 2004 promotes study abroad
- 千里馬計劃 “Thousand-Mile Horse Program” promotes post-doctoral research experience abroad
- 伯樂計劃 “Po-Le Program” attracts senior (retired) talents with Taiwan background to return for short-term position searching and long-term employment
- New program starting 2008 for foreign graduate students (study with scholarship at Chao-Tung or Tsing-Hua Universities and with guaranteed position at ITRI)
- Sabbatical-leave programs; Visiting researcher program; Foreign student internship

Data Source: Ministry of Education, Taiwan (R.O.C.)



## Access to Funding Sources

- *Increasing science & technology budget (defense excluded):  
~US\$1.5 bn in 2001 to ~US\$2.1 bn in 2004*
- *VCs invested ~US\$5.5 bn to create ~400 firms and ~US\$63 bn/yr revenue  
from 1984 to 2004*
- *...however, lack of deal flows and not much connected with international  
VCs have been the concerns...*

→ **Globalization of Taiwanese VC firms**

Source: 1. Taiwan Venture Capital Association (2005)  
2. Martin Haemmig (2005)





# Access to Technology Sources: Becoming a Major IP Generator

*Number of U.S Patents Granted and Ranking by Assignee Country*

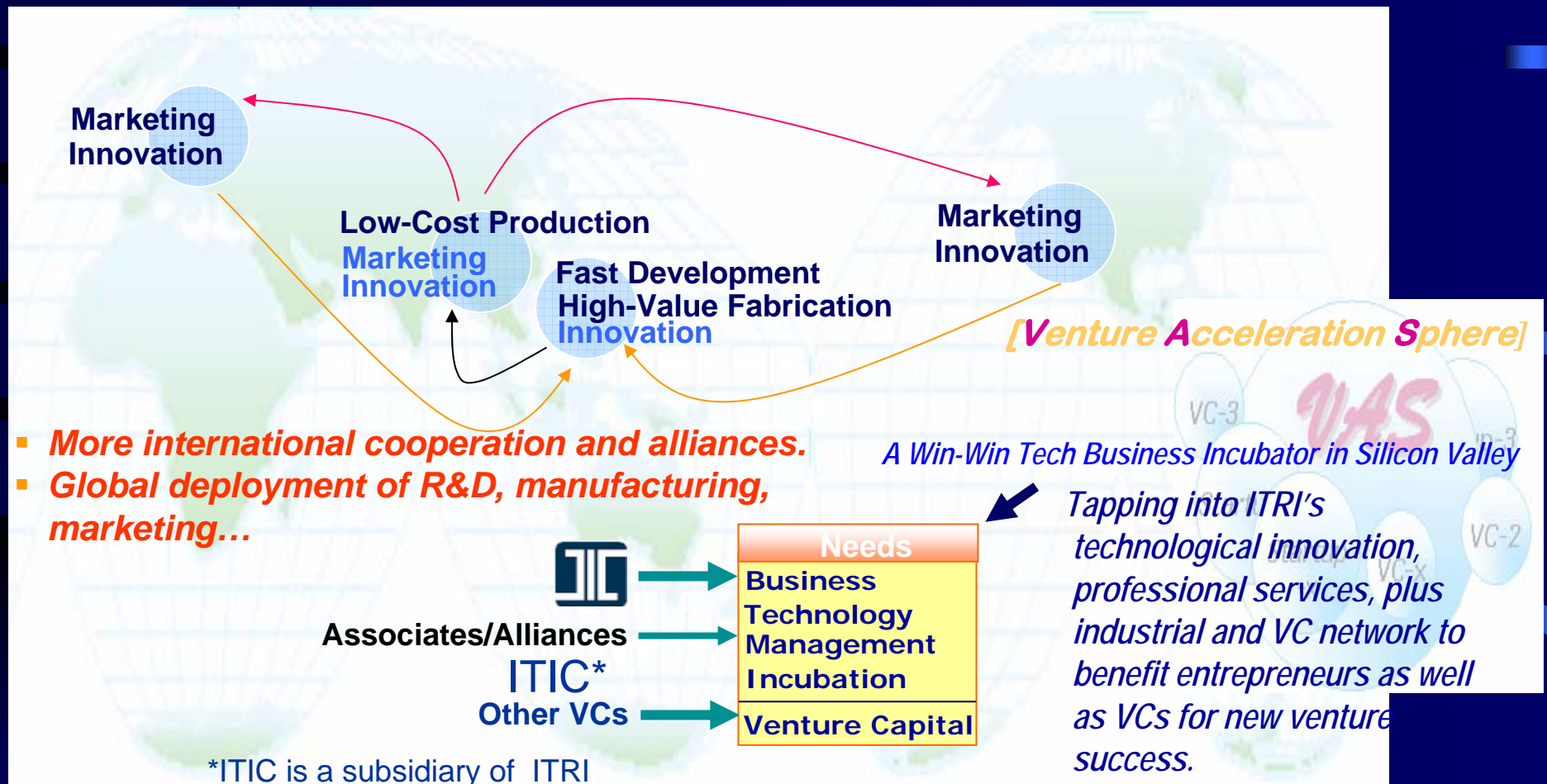
Country	2003		2004		2005		2006	
United States	1	87,893	1	84,271	1	74,637	1	89,823
Japan	2	35,517	2	35,348	2	30,341	2	36,807
Germany	3	11,444	3	10,779	3	9,011	3	10,005
Taiwan	4	5,298	4	5,938	4	5,118	4	6,360
S. Korea	5	3,944	5	4,428	5	4,352	5	5,908
China (incl. Hong Kong)		573		715		685		969

- *Taiwan has been the 4th largest recipient of US patents*
- *Technology spill over from research institutes such as ITRI has been one of the major technology sources.*
- *Awareness and fundamental change:*
  - *Healthy respect for IP to have the freedom of not being OEMs*
  - *IPR is an asset for international deployment*
  - *Building up IP portfolio like a technology leader (instead of fast follower)*
- ➔ ■ *Some sizable firms have been investing more in R&D, sometimes joining with research institutes, in order to be more competitive.*
- *Reorganization and realignment of research institutes for higher impact of R&D*

Data Source: USPTO



# Extended Network and Linkage





# Investing in Infrastructure: More Science Parks



行政院國家科學委員會  
National Science Council

Since      Focus

**1980** Semiconductor  
Optoelectronics  
Biomedical



新竹科學工業園區  
Hsinchu Science Park  
Taiwan

**2003** Aviation  
Precision Machinery  
Optoelectronics



Central Taiwan Science Park

**1996** Optoelectronics



南部科學工業園區  
SOUTHERN TAIWAN SCIENCE PARK

Total: 3,723 ha.

Ilan Site\*

Longtang Site

Chubei Biomedical\*

Hsinchu Site

Chunan Site

Tonglou Site\*\*

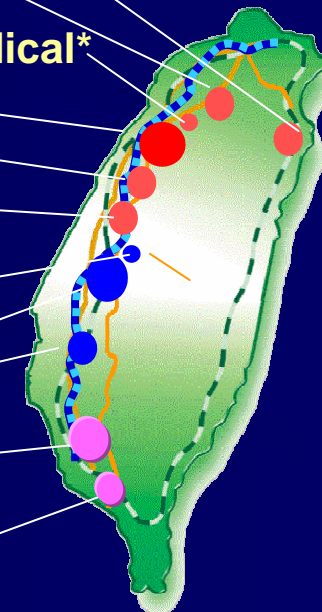
Huwei Site

Taichung Site

Houli Site

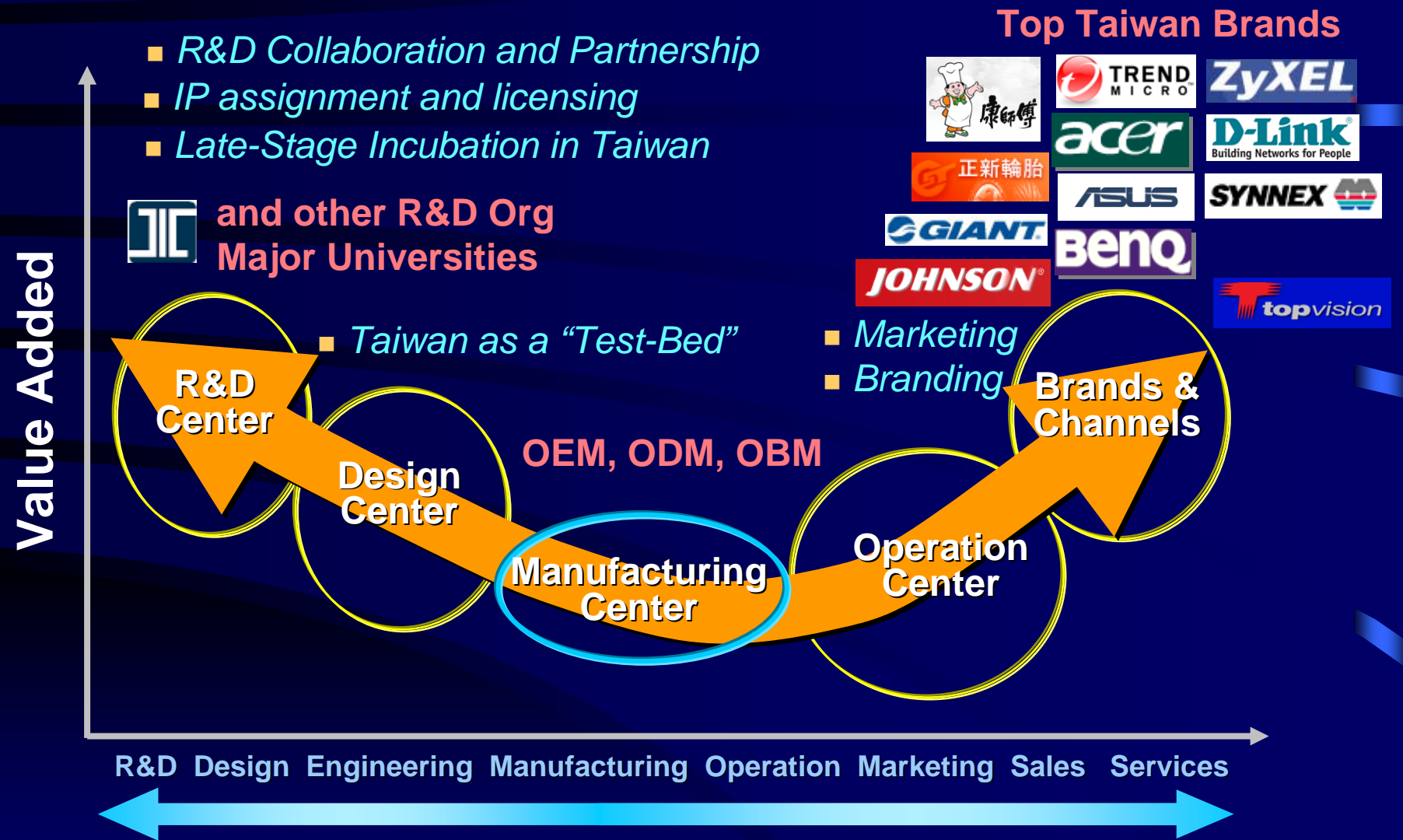
Tainan Site

Kaohsiung Site





# Global Value Addition: Branding & Marketing







## Biotech/Biomedical Initiatives

- Government invested more than US\$4.9 billion in biotech industry for the last 9 years
- Building up biopharma and medical devices industries
- Passed new (June 2007) “Biotech and New Drug Industry Development Law” to offer more incentives to researchers as well as investors



## Summary

**Taiwan**, with its unique *innovation system*, primarily involving **TDP**, **ITRI**, **HSIP**, has successfully created a high-tech industry and many *innovative clusters*,

but is facing new challenges while trying to move up the value chain...

...and responding with government policies and innovative high value creation

- **From “Cost Driven” to “Value Driven”**  
... to create value beyond OEM/ODM
- **Strengthen the innovation system**  
... to increase the return of investment in innovation
- **Emphasize on “innovation clusters”**  
... a proven approach to economic development





謝謝

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