

Internationalization of R&D – Perspectives from Outside and Inside of China

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Relevance: Why is China attractive for Foreign R&D?

- Majority of foreign R&D sites established for market reasons
 - China a potential market of 1.3 billion customers
 - Growing wealth of Chinese population
- Fairly inaccessible local science and technology
 - National R&D intensity: about 1.3% (advanced countries: about 2+%)
 - Increasing number of Chinese patents and Chinese papers
 - Total of 743'000 scientists and engineers annually (**second** worldwide)
- WTO and domestic reforms (IPR, law enforcement, VC, etc.)
- Bright people available for good price



- **BEA Systems, 2002: First ever int'l R&D site in China**
- **LG, 2002: Largest int'l R&D site in China**
- **Motorola, 2003: 18 R&D labs in China**
- **PRC Gov't, 2005: 700+ R&D centers in China**

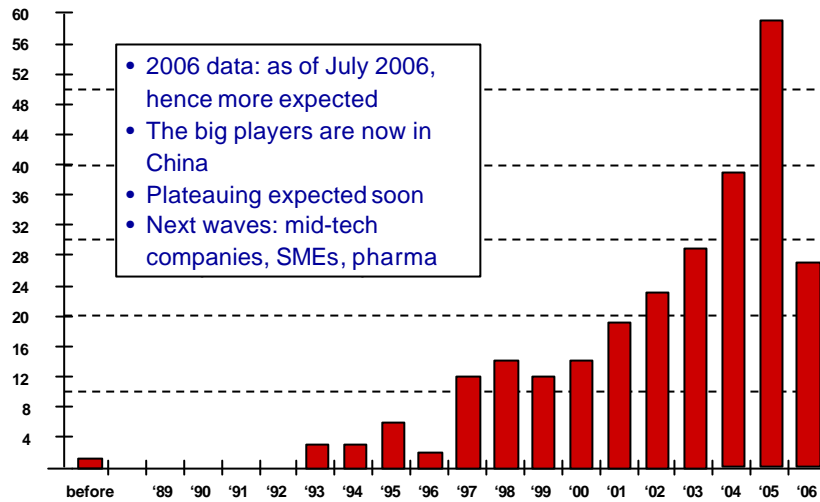
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Rise of Foreign R&D Labs in China

of R&D labs / year



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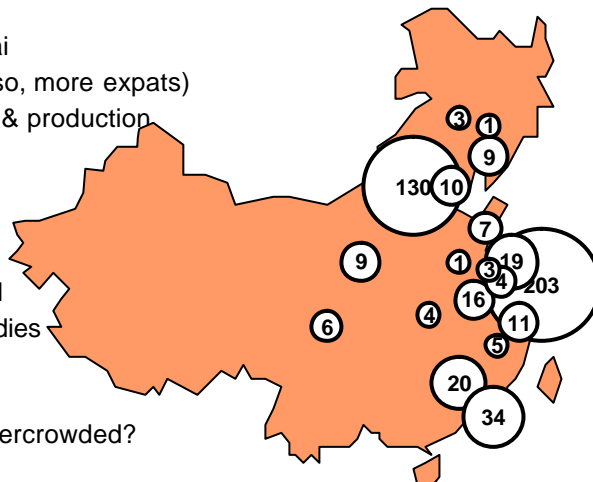
GLORAD R&D Database, 2006

Status: Sep 2006, n=313

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Foreign R&D Locations in China (est. 750 in 2005)

- Development in Shanghai
 - Historic reasons (also, more expats)
 - Close to customers & production
 - Fast-paced
 - Central location
- Research in Beijing
 - Standardization and decision-making bodies
 - > 100 universities
- Are Beijing, Shanghai overcrowded?
- But: Decision to be made case by case: account for industry and R&D focus (e.g., Pharma, TCM → Shanghai; IT, Genetics → Beijing)



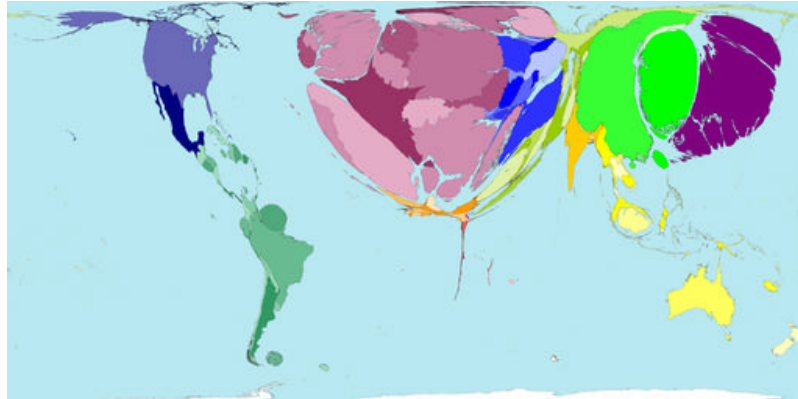
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Zedtwitz (2004): R&D in China. R&D Mgt

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Science Growth in the World



Territory size shows the proportion of the number of extra scientific papers that were published in 2001 compared with 1990, whose authors work there.

- Growth in US < Japan, China, Germany, Korea
- Most growth in Singapore
- 1990: 80 scientific papers / 100 mio persons
- 2001: 106 scientific papers / 100 mio persons
- 162'191 papers published on average, '90-'01

"Singapore is engaging robustly in the materials science research, as we position ourselves for the global, knowledge-driven economy, and for our next phase of development as a society."

Tharman Shanmugaratnam, 2003

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www.worldmapper.org

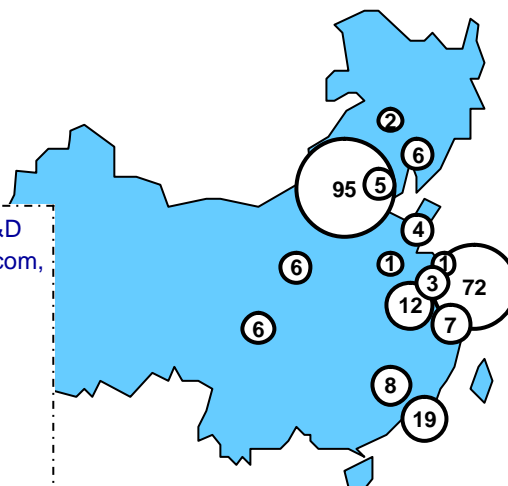
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R&D Locations in China (Telecom/IT/SW only)

Notable:

- Shanghai: 203 → 72
- Suzhou: 19 → 1
- Chengdu: 6 → 6

- About half of the foreign R&D centers in China are in telecom, software, and IT.
- Examples for this group:
 - Siemens
 - Motorola
 - France Telecom
 - Ebay
 - Alcatel
 - AMD



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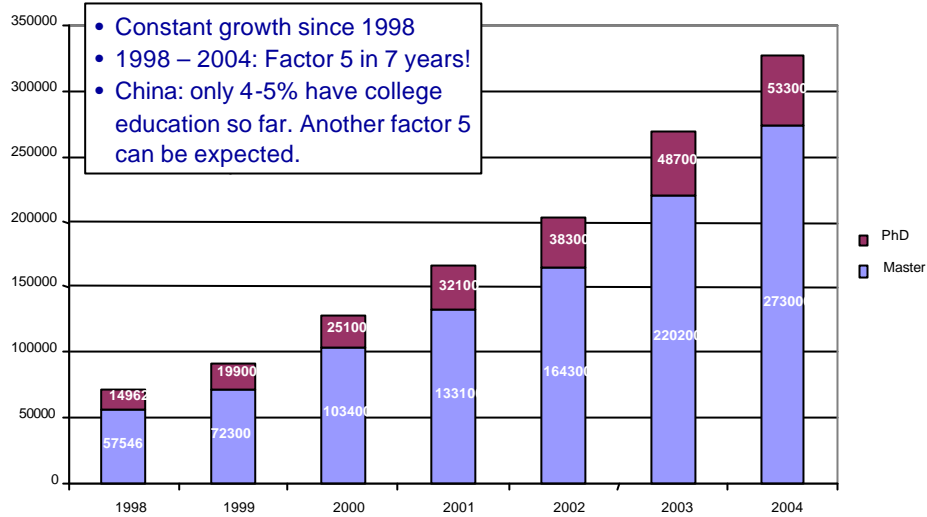
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In China, Number of Graduate Students is Increasing Fast

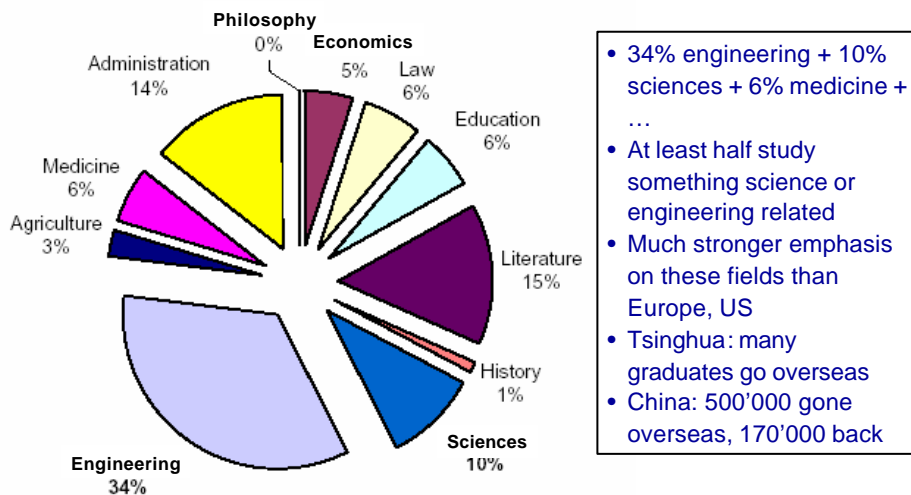


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Relative Share of Graduates from Different Faculties



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China as a SOURCE of Innovation?

Traditional View

- China imports technology from Western companies in return for market access.
- Chinese companies copy, don't invent.
- Chinese companies either receive gov't protection or innovate using copied Western business models.

Putting this View into Perspective

- Imitation is a natural (necessary?) step before innovation:
 - Japan, Korea, USA, Switzerland as examples
 - Artists/students, too, learn how to copy "the masters"...
- "Western" is really a base of about 20 different contributing countries:
China can become a top-5 player by gaining just a 10% "market share" in innovations.

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Comparison of R&D Salaries

1. Silicon Valley	100%
2. Other US locations	90-100+%
3. Western Europe	80-90-100+%
4. Eastern Europe	50%
5. India/China/Russia	30%

But:

- Home country usually has different staff structure
- Costs of training
- Costs of high turnover
- Costs of (lack of) quality
- ...

Case in Point:

Wuhan, Chengdu, Xi'An – all with significant cost advantages over Shanghai and Beijing – have not been able to attract a significant amount of foreign R&D centers.

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What Foreigners Say about Managing R&D Eng. in China

- Employee retention and turnover (10-20% p.a.)
 - Fear of IP loss
 - 6-8% salary increase p.a.
- Less effective if work unstructured or ambiguous
 - Lack of creativity
 - Lack of owning up
- Fast career growth expectations
- Strong needs to train people
- Demand for cutting-edge technologies, not me-too products
- Culture: a problem (leading people, etc.)
- English, Chinglish, etc: communication problems
- Tendency not to share information
- Chinese line managers: a must

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IPR Violations: Overview

- 7-10% of world wide trade are copies, counterfeits, pirated products
 - Estimated economic damage: 200-300 billion Euro
- Globalization and technological progress actually further piracy trend
- Focus on successful products for which there is a proven demand
- Products or packaging, documentation, etc.
- No adherence to standards with respect to quality, safety, health, environment, etc.
- Child labor and support of criminal activities!

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“Chinese R&D Engineers are Not Creative”

TRUE:

- Chinese education system and culture does not encourage individualistic expression and creativity

FALSE:

- Chinese people are inherently less creative (counter example: see overseas Chinese scientists and scholars)

What to Do:

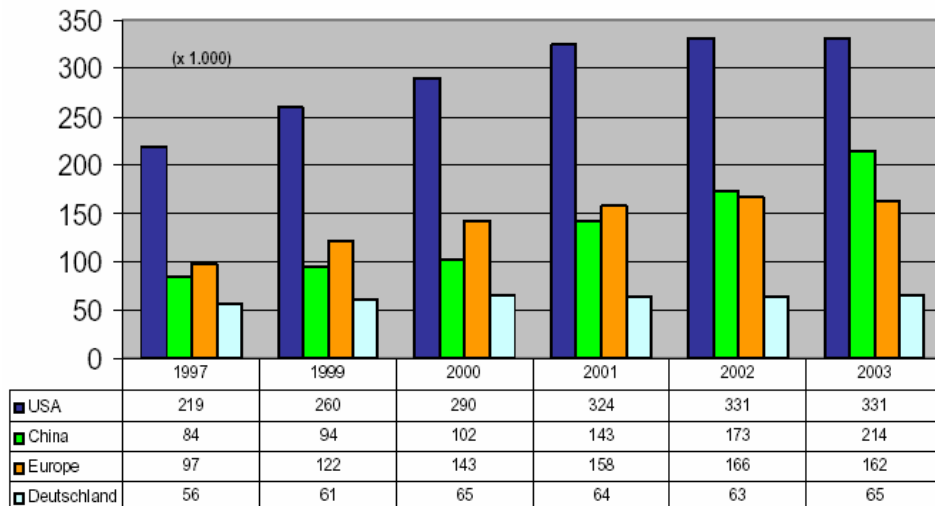
- Create a distinctly foreign/int'l environment where Chinese engineers can behave differently
- Have Chinese overseas returnees serve as leading examples
- Sensitize yourself to Chinese expressions of creativity and manage and reward accordingly

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Increasing Number of Patent Applications



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Chinese Innovations in Perspective: What Took Us so Long?

China

100 bc Paper invented in Gansu Province



128 Seismoscope invented



300 Compass developed

800 Gunpowder (also used for military applications)



1045 Printing / movable type

Europe

900 Paper introduced to Europe via Arabs

1800 Seismoscope reinvented in Europe

1150 Compass introduced to Europe

1300 Gunpowder introduced to Europe

1455 Gutenberg's printing press

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China-Grown Technology

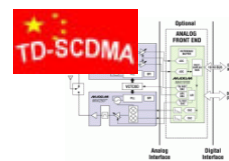
- Oct 15, 2003: Yang Liwei, **first Chinese astronaut** (= taikonaut), makes China the third country only engaged in manned space travel.



- **Cloning of human liver** related genes

- **TD-SCDMA** = Time Division-Synchronous Code Division Multiple Access, 3G mobile telecommunications standard; more flexible, less costly, greater spectrum efficient, lower power consumption than W-CDMA.

- **Artemether**, a novel anti-malarial drug



- **Sobuzoxan**, an anti-tumor drug

- **Huperzine A (HupA)**, a novel alkaloid isolated from a Chinese medicinal herb, was improves memory deficiencies in Alzheimer patients

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Chinese Industrial R&D and Innovation

E.g., Huawei:

- 44,000 employees, >10% of revenue dedicated to R&D, 48% of employees in R&D
- CMM5 certification – the highest accreditation available
- Member of 70 international standardization organizations
- E.g. ITU-T, 3GPP2, ETSI, OIF, RPR, OMA, TIA, TMF...
- Filed over 14'000 patent applications by mid of 2006 (up 8'000 within two years)
- Granted over 2'000 patents by mid 2006 (up 600 within two years)

E.g., CNPC:

- CNPC invested 4200M RMB in R&D in 2004
- CNPC has three hundred R&D institutes in China, including 7 institutes directly under HQ, 65 under the secondary companies, about 250 secondary branches R&D centre.
- 81 major research projects, including 15 national key ones and 66 company ones
- 594 patents were awarded

Others: ZTE, Haier, TCL, Lenovo, Dongfang Motors, Hisense, Li-Ning, Founder, etc.

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China's R&D: Why Internationalize...?

Why a Chinese firm would internationalize R&D:

- Local technology and market intelligence
- Hiring foreign experts
- Developing a global image
- Supporting local sales

Example Haier:

- #5 white-goods company worldwide
- Competes and cooperates with companies like Siemens, Whirlpool, GE
- R&D in Qingdao, Beijing, Guizhou
- R&D in Hong Kong (now PRC), London, Silicon Valley, Sydney

→ **A necessary (for some) but painful process!**

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Zedtwitz (2005): R&D from Developing Countries. UNCTAD

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Context of China's R&D Internationalization

- Most high-tech companies are **small** (600 p.) and **less than 15 years old** (World Bank)
- Even large companies (e.g., Lenovo) are **comparatively small** (just 4% of IBM's turnover)
- 50% of Chinese companies' **supply network is within the city**, and 75% within China (Steinfeld, 2002)
- Chinese companies: mostly **pursue opportunities with low barriers of entry**
- Extent of Chinese companies' internationalization: **patchy**, but mostly low
- "Zou Chu Qu" policy: Go abroad! R&D encouraged where local S&T is strong, and international S&T exchange

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Patterns of R&D Internationalization

Home Country	Advanced	Type 2 MODERN <i>(e.g., US → China, EU → India)</i>	Type 1 TRADITIONAL <i>(e.g., US → EU, JP → US)</i>
	Developing	Type 4 EXPANSIONARY <i>(e.g., China → Brazil, India → China)</i>	Type 3 CATCH-UP <i>(e.g., China → US, India → EU)</i>
		Developing	Advanced
		Host Country	

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Only International R&D Locations (776)

Advanced Home Country	Type 2: Modern 194 (25%)	Type 1: Traditional 496 (64%)
	Type 4: Expansionary 22 (3%)	Type 3: Catch-Up 64 (8%)
Developing	Developing	Advanced

Host
Country

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Only Chinese R&D Locations (71)

Advanced Home Country	Type 2: Modern 0 / 0 All / Intl	Type 1: Traditional 0 / 0 All / Intl
	Type 4: Expansionary 51 / 11 All / Intl	Type 3: Catch-Up 26 / 26 All / Intl
Developing	Developing	Advanced

Host
Country

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Implications for R&D from China

- Chinese companies are about to set up R&D in hot spots around the world
 - Boston, Silicon Valley, Japan, UK, Germany
 - But also India, South America, Korea, Western Asia, etc.
- Chinese companies are facing steep learning challenges with respect to doing R&D, and managing international organizations
- The Chinese have a tremendous willpower to adopt Western technologies and demonstrated that they can do so fast
- If the technology doesn't come to China easily, local R&D centers can source technology where it is created, and secure global ownership rights
- Chinese companies will compete over top graduates from Western universities

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Implications for R&D in China

- China will become more important as a [source](#) of technology
- Probably several hundred more R&D sites (also by SMEs) will be established in China
- Are there enough knowledgeable and experienced entrepreneurial R&D managers?
- R&D in China for cost-saving: tactical approach only. What is your China strategy? Answer should determine R&D decision and R&D mission.
- Research strategy in China:
 - Well connected to global R&D efforts
 - Work on China-related topics (business, science)
 - “Natural to do in China
 - Difficult to do from the global”

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