

# Foreign R&D in China – The Case of Telecommunications

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# Summary

- This presentation is structured around four trends, most of which are centered around new information and telecommunication technologies and their use.
- The basic premises are that
  - ICT R&D is well represented in China
  - ICT also allows indigenous R&D to come to fruition faster
- What we (Westerners) don't see yet (because we don't want to or because we are unable to) is local Chinese R&D results. The presentation does not focus on this as the evidence would be provided verbally or in a video I would have shown, but it IS there.
- If you have any questions or comments, please email me at the email address provided on each page.

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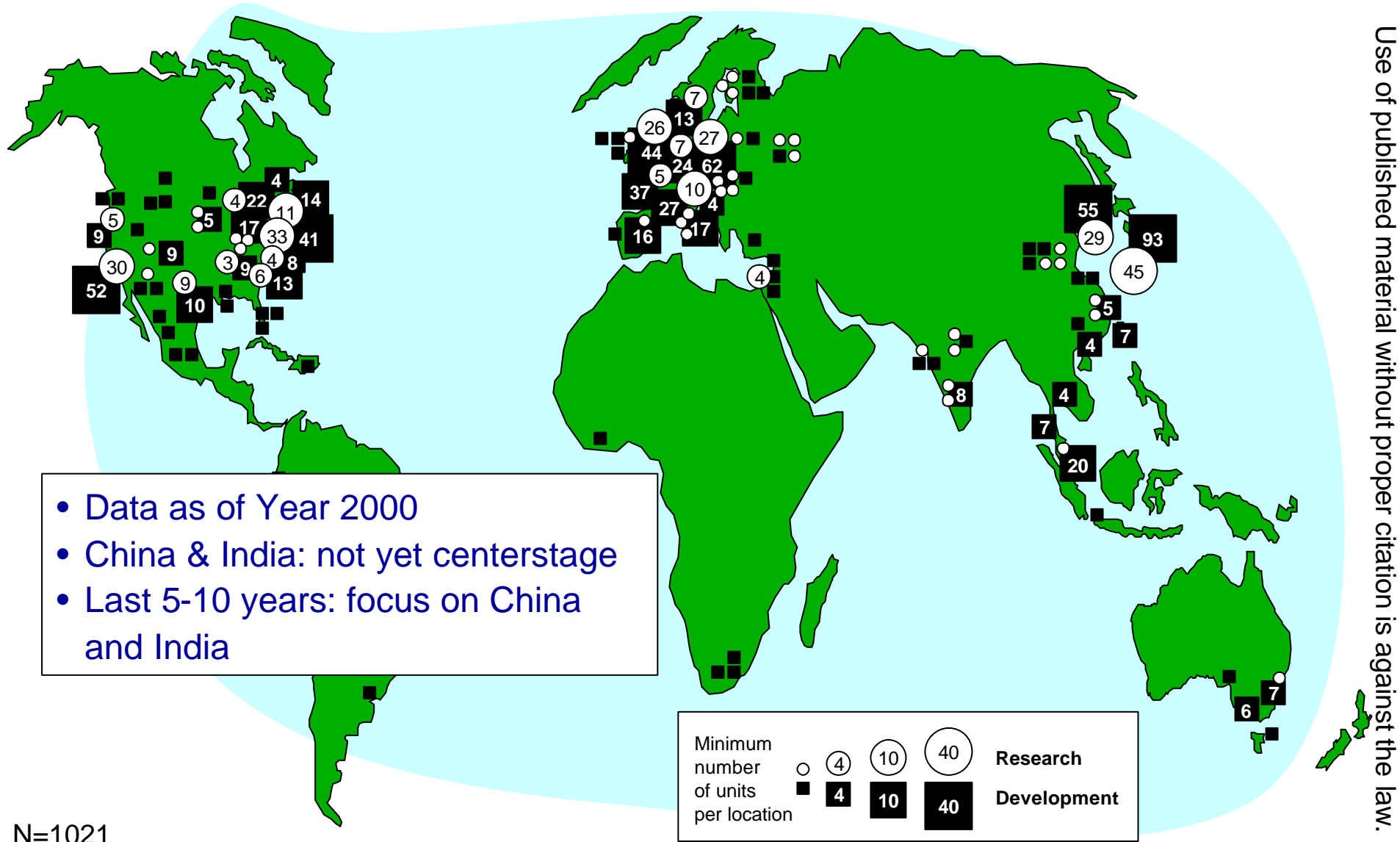
## Trend 1: More International and Local R&D

**TREND 1: R&D will follow the attraction of local markets and local scientific communities.**

- Fewer and fewer companies will be able to operate R&D exclusively from the home base.
- More small research sites (listening posts) will be established near centers of high scientific activity.
- More R&D will be carried out in collaboration with local universities and flexible but highly competent start-ups.
- Important customers will be integrated in the overall product development process (lead-users).

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# Worldwide Dispersion of R and D Sites (2000)



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# Foreign R&D in Asia

## Japan

- Increasing share (but still at below 10%) of Japanese R&D done abroad
- Innovation leadership in many key areas identified as future core technologies
- Japan #2 worldwide in terms of number of R&D spending firms (22%)
- Hundreds of foreign R&D units in Japan: #5 worldwide as host of foreign R&D: only 3.4% of R&D done by foreign companies

## Korea

- 15 new foreign R&D centers in 2004, 12 in 2005
- Among them: Microsoft, Siemens, Sun Microsystems, etc.
- Strong domestic technology companies: Samsung, LG, Hyundai, etc
- Korea #8 worldwide in terms of number of R&D spending firms
- #26 worldwide as host of foreign R&D: only 1.6% of R&D done by foreign companies

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## Trend 2: More int'l R&D in Countries Outside the Triad

### **TREND 2: Transnational R&D follows talent into newly industrialized countries.**

- First-rate education in sciences and engineering in Eastern Europe, Australia, India and parts of East Asia.
- Local centers-of-excellence in South America, South Africa, China, India, Southeast Asia.
- New local R&D units of multinational companies often equipped with powerful information and communication technology.
- Repatriated scientists and students speak English well and are highly ICT-literate.

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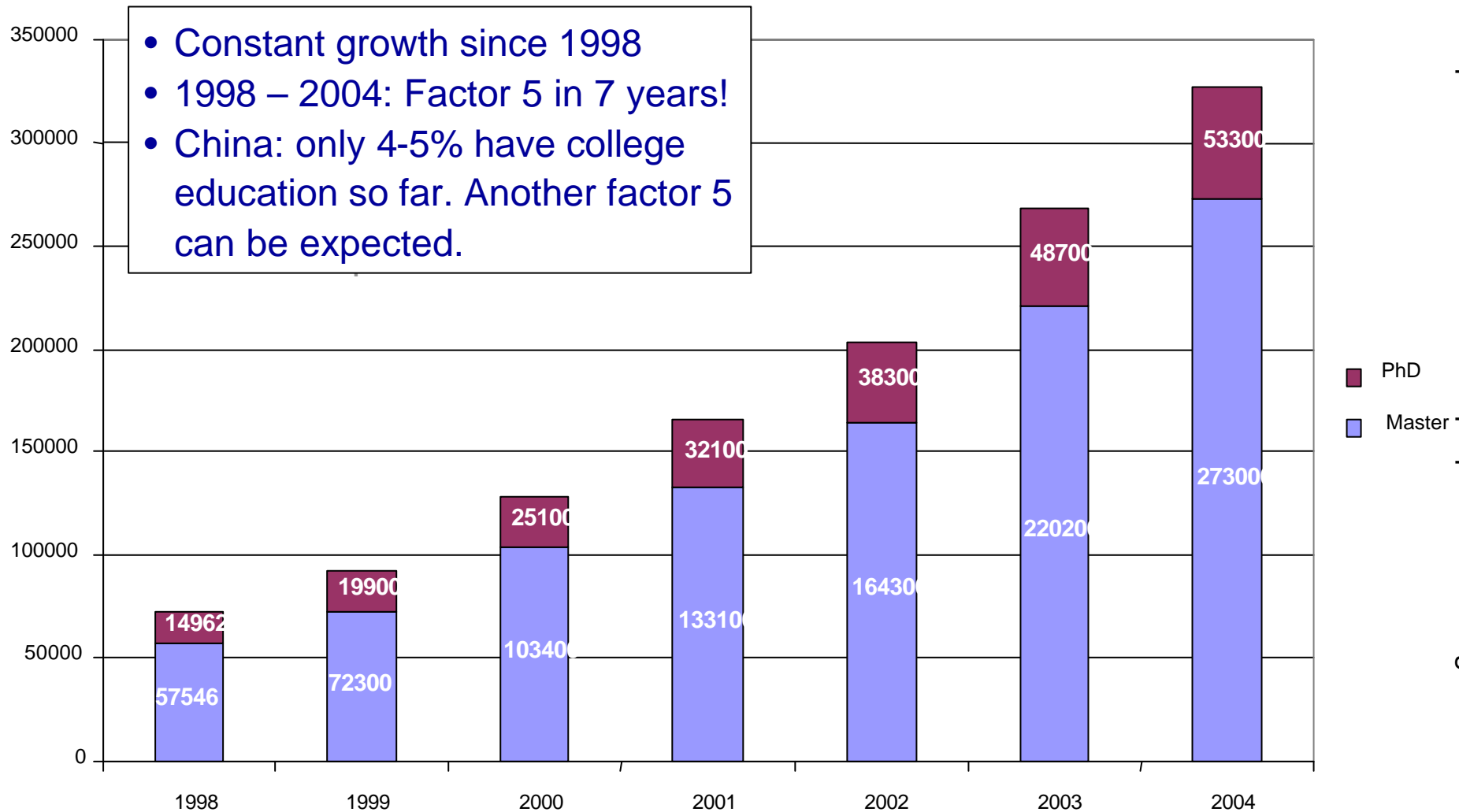
# China: Composition of Industrial R&D by Type

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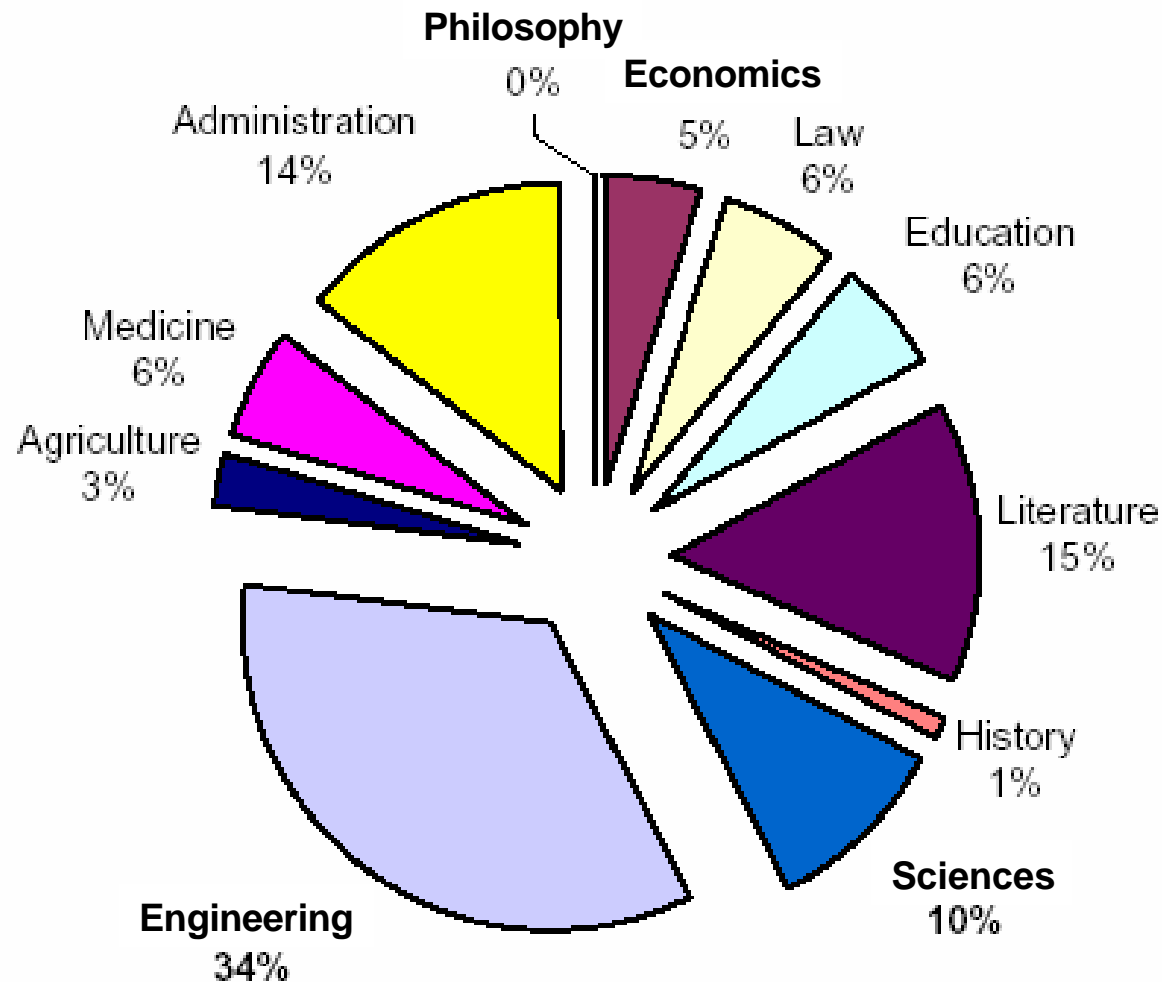
in %	<u><b>China</b></u>	<u>Korea</u>	<u>US</u>	<u>Japan</u>	<u>UK</u>	<u>France</u>	<u>AUS</u>
Basic Research	<b>0.4</b>	6.1	8.0	5.8	4.8	4.5	3.3
Applied Research	<b>7.1</b>	21.7	19.0	20.5	34.4	29.3	19.3
Experimental Development	<b>92.5</b>	72.2					

- Many innovations in the West ultimately trace back to basic research.
- ... made 20-50 years before the innovation!
- China still has a long way to go.

# In China, Number of Graduate Students is Increasing Fast



# Relative Share of Graduates from Different Faculties

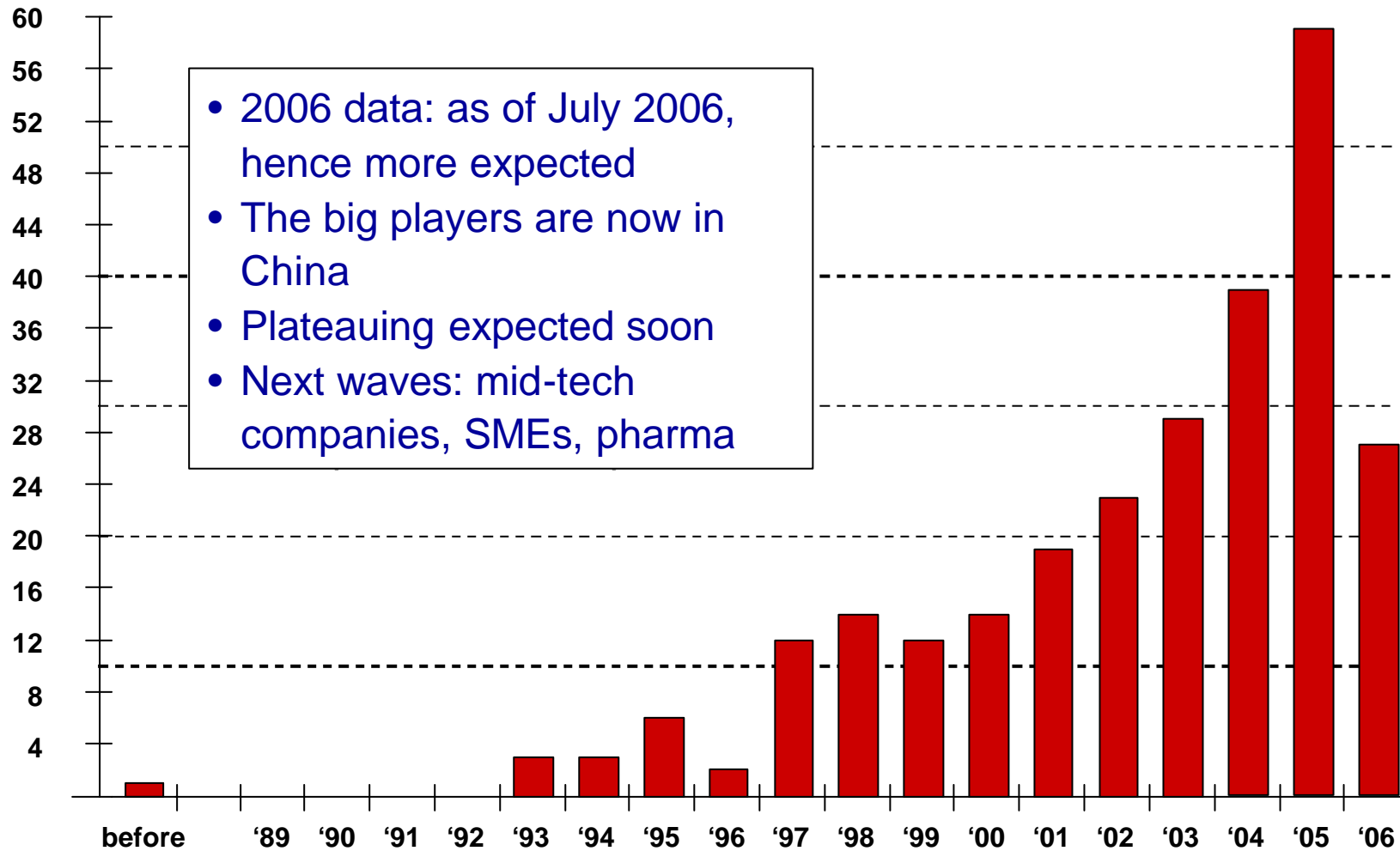


- 34% engineering + 10% sciences + 6% medicine + ...
- At least half study something science or engineering related
- Much stronger emphasis on these fields than Europe, US

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# Rise of Foreign R&D Labs in China

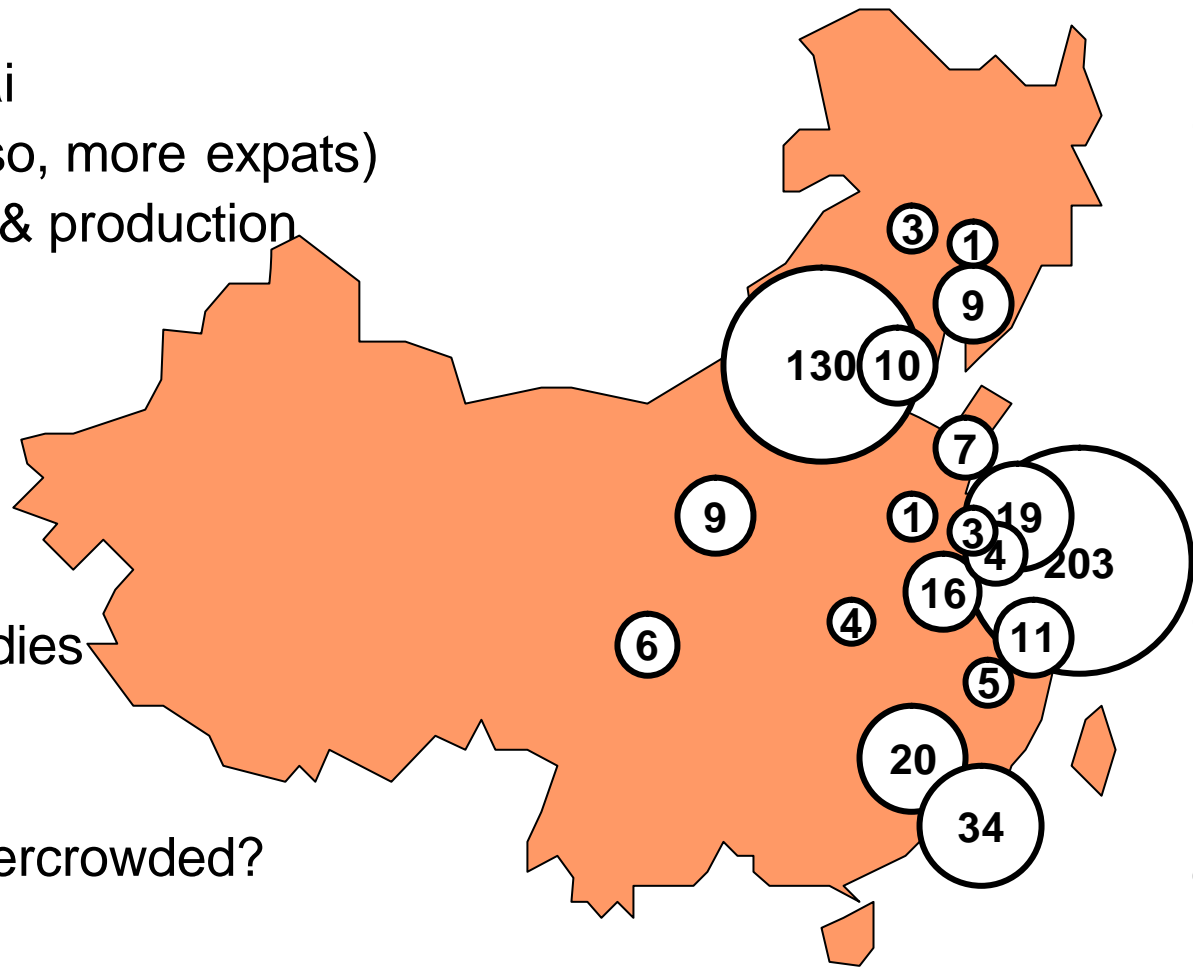
# of R&D labs / year



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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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# Are Shanghai and Beijing Overcrowded?

Of 495 R&D units, 333 (about 67%) were located in Beijing and Shanghai.  
(Of 700 R&D in the US, 188 (26%) were located in California.)

## Advantages of second tier cities:

- Availability of skilled labors (e.g. Jiaotong U in Xi'An)
- Lower operation costs (e.g., Wuhan one third of m2 costs)
- Lower labor costs and mobility (e.g. Chengdu half or Shanghai)
- More government attention

## Problems:

- Image of a less developed city
- Fewer international flights
- Less attractive for local and non-local managers and engineers

- “Second tier cities” still have 5-7 mio inhabitants
- China has 170 cities of >1 mio inhabitants

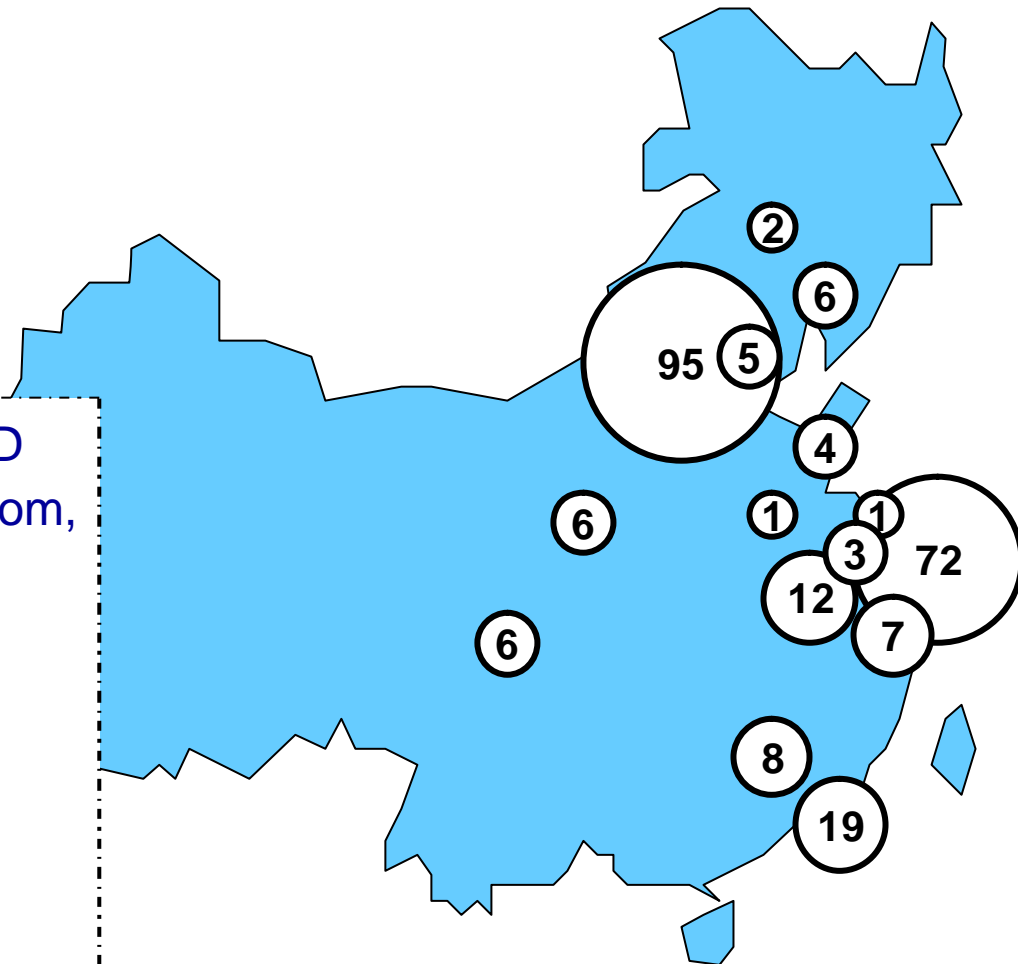
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# R&D Locations in China (Telecom/IT/SW only)

## 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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## Issue #1: Intellectual Property in China

- Traditional attitude to art and craftsmanship promoted copying of old masters
  - “To Steal a Book is an Elegant Offense”
  - Useful for diffusion of technology, but not necessarily for invention
- Although China has been home to a large number of important inventions, few were protected by any legal institutions (such as IPR)
- The current record of IPR in China shows weak incentives for invention

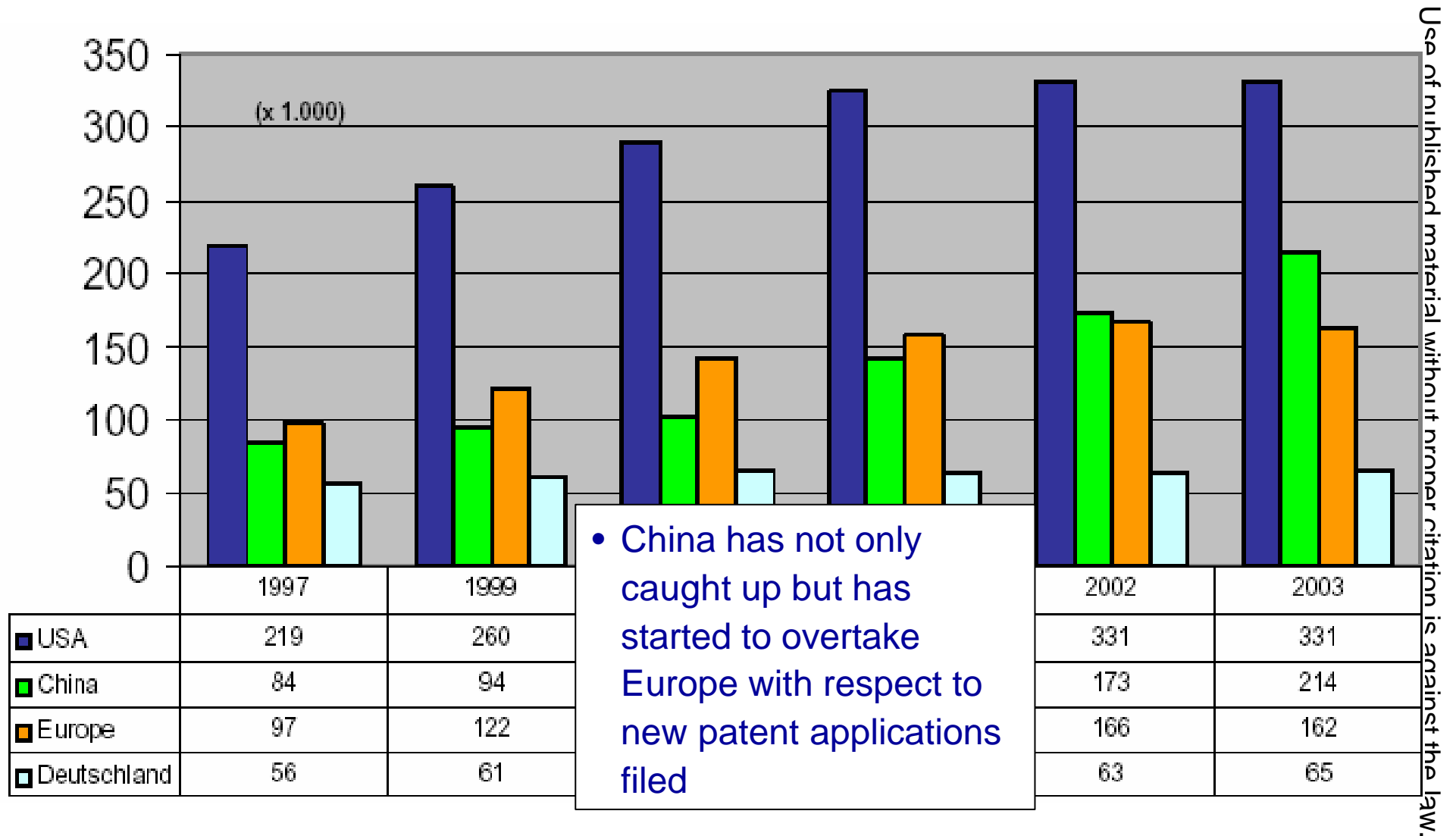
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# Ten Technologies to Watch in China

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Field	Technology
<i>Information &amp; telecommunication</i>	<ol style="list-style-type: none"><li>1. Next-generation mobile telecommunication (beyond 3G)</li><li>2. Next-generation networks</li><li>3. Nanometer chips (targeting 12" 90/65nm chips)</li><li>4. Chinese information processing</li></ol>
<i>Life sciences and biotechnology</i>	<ol style="list-style-type: none"><li>5. Functional genomics</li><li>6. Medical biotechnology</li><li>7. Bioinformatics</li><li>8. Functional proteomics</li><li>9. Technology for breeding new trans-gene farm crops</li></ol>
<i>New materials</i>	<ol style="list-style-type: none"><li>10. Nanomaterials and nanotechnologies</li></ol>

# Increasing Number of Patent Applications



# Chinese Inventions: Brain-Machine-Interfaces

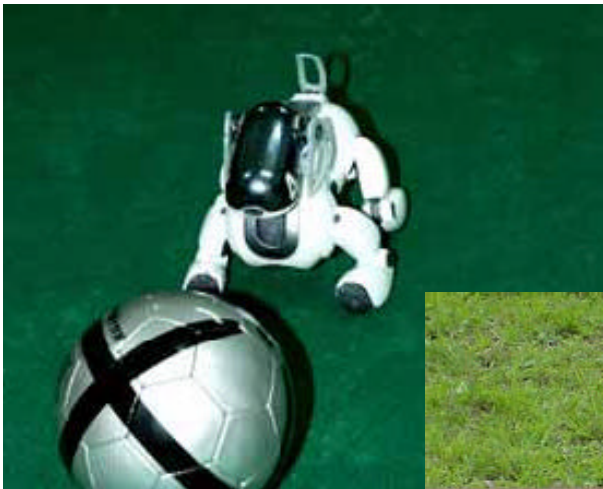
Where: Tsinghua Institute of Neural Engineering at the Tsinghua School of Medicine

When: Spring 2006

What: Linking brain activity to a computer, thus interfacing with electronic/mechanical devices



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## Demonstrated Applications:

- Control a robot dog to kick a ball

## Anticipated Applications:

- Controlling artificial limbs
- Steering wheelchairs
- Surfing the internet by mind control
- Guiding remote assistants (e.g., for rescue)

# Chinese Industrial R&D and Innovation

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## E.g., Huawei:

- 14,500 employees, >10% of revenue dedicated to R&D, >40% of employees in R&D
- CMM5 certification – the highest accreditation available
- Member of 60 international standardization organizations
- E.g. ITU-T, 3GPP2, ETSI, OIF, RPR, OMA, TIA, TMF...
- Filed over 6500 patent applications by end of 2004
- Granted over 1400 patents to date

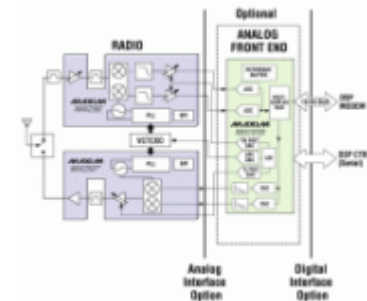
## E.g., CNPC:

- 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.

# Chinese Inventions: TD-SCDMA

- TD-SCDMA = Time Division-Synchronous Code Division Multiple Access
- 3G mobile telecommunications standard
- Pursued by the Chinese Academy of Telecommunications Technology (CATT), Datang and Siemens AG, in an attempt to develop home-grown technology and not be "dependent on Western technology".
- Siemens also in a JV with Huawei (for marketing and manufacturing).
- On January 20, 2006, Ministry of Information Industry of the People's Republic of China formally announced that TD-SCDMA is the country's standard of 3G mobile telecommunication.
- TD-SCDMA 3G phones are expected to become available at the end of 2006 and other 3G networks will be delayed until TD-SCDMA is ready.
- More flexible, less costly, greater spectrum efficient, lower power consumption than W-CDMA...



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## Trend 3: More Int'l R&D due to Advances in IC-Technology

**TREND 3: Better information and communication technologies enhance the functionality of int'l R&D teams.**

- Expansion of the internet (backbone and net-periphery) and information throughput (bandwidth).
- 'Virtual reality' technologies, including sensory/haptic and holographic media, are under development.
- Better ICT-based project management tools, e.g. groupware and intranets.
- Increasing adaptation of work processes that suit the context-specific exchange and interpretation of explicit information.

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## Trend 4: More Int'l R&D from Emerging Countries

**TREND 4: Emerging countries develop firms with global R&D capabilities competing for local and global talent.**

- Returnees as seeds of local R&D management capabilities
- Strong investments in certain technology areas in China, India, Korea
- Increasing outward investment of China, India, Korea leads to M&A of local R&D firms and establishment of own global R&D networks
- Foreign firms pick up shortages of home-based university funding
- Foreign firms will compete over foreign graduates at home universities

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