CHINA IN THE GLOBAL KNOWLEDGE ECONOMY
KEY ISSUES AND CHALLENGES

Richard P. Suttmeier,
University of Oregon
petesutt@uoregon.edu
A NOTE ON HISTORY

- RAPID EXPANSION OF RESEARCH AND EDUCATION IN THE ’49-’65 PERIOD
- THE DISRUPTIONS OF THE CULTURAL REVOLUTION
- ’78 RECONSTITUTING THE SYSTEM
  - CAS
  - MINISTRIES
  - UNIVERSITIES
  - LOCAL GOVERNMENTS
  - THE DEFENSE SECTOR
- ’85 INITIATING REFORM
THE REFORM ERA – 1980s

- THE TECHNOLOGY TRANSFER STRATEGY
  - HARDWARE PURCHASES
  - LICENSING
  - FDI
  - HUMAN EMBODIMENT

- SLASHING R&D BUDGETS

- REVITALIZATION OF HIGHER ED/WORLD BANK

- A NATIONAL SCIENCE FOUNDATION

- “INTELLECTUAL PROPERTY” & PATENT OFFICE

- FROM “RENOVATION” TO “INNOVATION” (?)
THE REFORM ERA – 1990s

- RAPID ECONOMIC GROWTH
- EXPANDED FDI
- “MARKET FOR TECHNOLOGY” STRATEGY
- “NATIONAL PROGRAM” EXPERIENCES
- GULF WAR
- ANTICIPATING WTO
- 1995
  - “DECISION TO ACCELERATE THE DEVELOPMENT OF SCIENCE AND TECHNOLOGY”
  - “KEJIAO XINGUO” (“REVITALIZE THE NATION THROUGH SCIENCE AND EDUCATION”)
EVOLVING POLICY ELEMENTS (1)

- STRENGTHEN HIGHER ED.
- INCREASE R&D EXPENDITURES
- TARGETTED NATIONAL PROGRAMS
  - “863”
  - “KEY TECHNOLOGIES”
  - “973”
  - INFRASTRUCTURE (KEY LABS, ERCs, “MEGAs”)
  - INDUSTRIAL EXTENSION
  - MAJOR DEDICATED PROJECTS
- EXPLOIT GLOBALIZATION
EVOLVING POLICY ELEMENTS (2)

MAJOR DEDICATED NAT’L PROJECTS (2001-5)

- SLSICs AND SOFTWARE
- INFO SECURITY, E-GOV, E-BANKING
- FUNCTIONAL GENOMICS, BIO CHIPS
- ELECTRIC CARS
- HI SPEED MAGLEV
- MEDICINE
- PROCESSING AGRIC. PRODUCTS
- DAIRY PRODUCTS
- FOOD SECURITY
- WATER CONSERVATION
- WATER POLLUTION
- TECHNICAL STANDARDS
EVOLVING POLICY ELEMENTS (3)  
THE “INNOVATION SYSTEM”  
PERSPECTIVE

- RESEARCH-PRODUCTION LINKAGES
- VENTURE CAPITAL
- IPR
- “INFORMATIZATION”
“MEDIUM TO LONG TERM PLAN”
2006-20

- “INNOVATION-ORIENTED SOCIETY”
- GERD/GDP: 2-2.5% BY 2020
- STRESS ON INDIGENOUS INNOVATION
  ▶ REDUCE DEPENDENCE ON IMPORTED TECHNOLOGY (END OF “MARKET FOR TECHNOLOGY”)
  ▶ ONE OF 5 WORLD LEADERS IN PATENTING
  ▶ LEADER IN CITED PAPERS
  ▶ SETTER OF TECHNICAL STANDARDS
“MLP” (2)

- $3,000 AVERAGE PER CAPITA INCOME
- SUSTAINABLE DEVELOPMENT THRU S&T
- PICK THE BIG PAY-OFF PROJECTS
- STRESS INTER-DISCIPLINARITY
- CIVILIAN-MILITARY INTEGRATION
- ENHANCE ROLE OF ENTERPRISES
- STRESS HUMAN RESOURCE DEVELOPMENT
MLP (3)

- S&T in support of the provision of public goods - 11 key areas of national needs
- 8 areas of frontier technologies
- 13 national engineering “megaprojects”
- 4 science megaprojects
- The international implications
CAS – INSTITUTIONAL MISSIONS

▶ BASIC RESEARCH
▶ HIGH TECH
  ▪ R&D
  ▪ INDUSTRIALIZATION
▶ REGIONAL DEVELOPMENT
▶ PUBLIC GOODS
▶ EDUCATION
▶ HONORIFIC FUNCTIONS
▶ THINK TANK
### Ratio of R&D Expenditure 2004

#### Table: R&D Expenditure

<table>
<thead>
<tr>
<th></th>
<th>R&amp;D EXPENDITURE</th>
<th>BASIC</th>
<th>APPLIED</th>
<th>DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td>1966.6</td>
<td>118</td>
<td>401.19</td>
<td>1447.42</td>
</tr>
<tr>
<td>CAS</td>
<td>93.20</td>
<td>33.53</td>
<td>53.39</td>
<td>6.28</td>
</tr>
<tr>
<td>CAS AS % OF</td>
<td>4.74%</td>
<td>28.42%</td>
<td>13.31%</td>
<td>0.43%</td>
</tr>
</tbody>
</table>
THE UNIVERSITY SECTOR

- 209,000 RESEARCHERS WORKING IN CHINESE UNIVERSITIES
- 50% OF THE NATIONAL AWARDS FOR SCIENTIFIC RESEARCH
- 70% OF THE PAPERS INDEXED BY SCI/EI/ISTP ARE FROM UNIVERSITIES
- 12000 INVENTION PATENTS (2004)
# THE ROLE OF RESEARCH UNIVERSITIES IN CHINA’S R&D

<table>
<thead>
<tr>
<th>Program in year 2004</th>
<th>NSF for Innovative Research Groups</th>
<th>NSF for Distin-guished Young Scholars</th>
<th>NSF</th>
<th>973</th>
<th>863</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>General</td>
<td>Key</td>
<td>Major</td>
</tr>
<tr>
<td>Total grant</td>
<td>20</td>
<td>157</td>
<td>7711</td>
<td>224</td>
<td>215</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Univ. granted</td>
<td>11</td>
<td>99</td>
<td>6044</td>
<td>146</td>
<td>145</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>%</td>
<td>55%</td>
<td>63%</td>
<td>78%</td>
<td>65%</td>
<td>67%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Major national projects undertaken by Univ.

*Source: Annual Report on S&T Progress of Chinese Universities 2004*
# The role of research universities in China’s R&D

<table>
<thead>
<tr>
<th>Lab construction Program/ by the end of year 2004</th>
<th>National lab</th>
<th>State key lab</th>
<th>ERC (Engineering Research Center)</th>
<th>University Science Park</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial launch</td>
<td>5</td>
<td>183</td>
<td>251</td>
<td>42</td>
</tr>
<tr>
<td>2nd batch passed review by MOST</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total launched</td>
<td>5</td>
<td>183</td>
<td>251</td>
<td>42</td>
</tr>
<tr>
<td>Lab based in Univ.</td>
<td>12</td>
<td>72</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>%</td>
<td>70%</td>
<td>61.7%</td>
<td>28.7%</td>
<td></td>
</tr>
</tbody>
</table>

| Lab based in Univ. | 57% | 70% |

**Source:** Annual Report on S&T Progress of Chinese Universities 2004
THE COOPERATION OF RESEARCH UNIVERSITIES AND INDUSTRY

- IMPORTANTANCE OF INDUSTRIAL COOPERATION.
- ABOUT 50% RESEARCH FUNDS OBTAINED BY CHINESE RESEARCH UNIVERSITIES ARE FROM INDUSTRY.
- MANY R&D RESULTS OF UNIVERSITY ARE DIRECTLY USED IN (TRANSFERRED TO ) INDUSTRY.
COOPERATION OF RESEARCH UNIVERSITIES AND INDUSTRY

► MANY COMPANIES HAVE JOINT LABS WITH UNIVERSITIES, E.G.
  - EG., TSINGHUA - 63 JOINT INDUSTRIAL LABS WITH ABOUT 60 COMPANIES
  - 20 WITH MNCs

► LARGE AMOUNT OF RESEARCH FUNDS BY INDUSTRY GOING TO UNIVERSITIES FOR TECHNOLOGY TRANSFER
  - EG., ABOUT 66 M$ FROM DOMESTIC FIRMS AT TSINGHUA
  - 26 M$ FROM MNCs (2005)
THE COOPERATION OF RESEARCH UNIVERSITIES AND INDUSTRY

- IMPORTANCE OF SPIN-OFFS
  - FOUNDER FROM PEKING U: A LEADING PC COMPANY IN CHINA
  - NUCTECH FROM TSINGHUA: WORLD’S LARGEST MARKET SHARE OF CONTAINER INSPECTION

- UNIVERSITY’S SCIENCE PARKS ARE IMPORTANT HIGH-TECH INCUBATORS
“THE ENTERPRISE PROBLEM”

- EXPECTED ROLE IN NIS
- CONFLICTING EVIDENCE
  - SHARE OF R&D SPENDING
  - INDUSTRIAL SURVEY DATA
  - R&D/VALUE ADDED, R&D/Sales
  - PATENT DATA
- OUTSOURCING
  - UNIVERSITIES, GRIs
  - OVERSEAS
GERD BY SOURCE OF FUNDS AND SECTOR OF PERFORMANCE

按经费来源分 By source of funds

按执行部门分 By sector of performance

政府 Government
企业 Business
国外 Abroad
其他 Others

研究与开发机构 Research institutes
企业 Business
高等学校 Higher education
其他 Others
HIGH-TECHNOLOGY INDUSTRY EXPENDITURE ON R&D AND AS A PERCENTAGE OF VALUE ADDED

[Graph showing R&D expenditure and percentage of value added for different high-technology industries, with values annotated on the chart.]
DOMESTIC SERVICE INVENTION PATENT APPLICATIONS FILED AND PATENTS GRANTED BY SIPO BY SECTOR

申请量 Patent applications

64.7% 23.2% 10.9% 1.2%

授权量 Patents granted

28.6% 19.8% 50.3% 1.3%

- 大专院校 Universities and colleges
- 科研单位 Scientific research institutions
- 工矿企业 Industrial enterprises
- 机关团体 Organizations
NATIONAL IMPORTS AND EXPORTS OF HIGH-TECH PRODUCTS
GERD IN SELECTED COUNTRIES
R&D PERSONNEL IN SELECTED COUNTRIES

- China 2004: 1152.6
- Japan 2003: 882.4
- Germany 2003: 480.6
- France 2002: 343.7
- Canada 2002: 177.1
- Italy 2002: 164.0
- Russia 2003: 973.4
- Korea 2003: 186.2

R&D personnel per 10,000 labor force

单位: 人年

千人年 1,000 person-years

R&D人力资源 R&D personnel
每万劳动力中R&D人力资源 R&D personnel per 10,000 labor force
NATIONAL S&T PUBLICATIONS

In domestic journals
Catalogued by SCI, EI and ISTP

千篇 1,000 papers
GOVERNMENT S&T
APPROPRIATION BY LEVEL

亿元 100 million yuan


中央 Central

地方 Local

199 216 243 275 290 356 350 444 511 609 692

69 87 106 134 149 188 226 259 305 336 403
ACHIEVEMENTS AND CHALLENGES

- TECHNOLOGY POLICY
- SCIENCE AND SOCIAL NEEDS
- BASIC SCIENCE
- INTERNATIONAL COLLABORATION
- ROLE OF THE LONG TERM PLAN ("MLP")
- NEW CHALLENGES OF GOVERNANCE
ISSUES: TECHNOLOGY POLICY

CHALLENGES

► GLOBAL PRODUCTION NETWORKS
► RELATIVE GAINS
► CHINESE IP?
► CHINESE STANDARDS?
  ▪ 3G
  ▪ RFID
  ▪ ETC.
► TECHNOLOGICAL DEPENDENCY & THE ENTERPRISE PROBLEM
► LOCAL GOVERNMENTS AND REGIONAL INNOVATION SYSTEMS
ISSUES: SCIENCE AND SOCIAL NEEDS

- NEEDS
  - ENERGY
  - HEALTH
  - AGRICULTURE
  - ENVIRONMENT

- INSTITUTIONAL ARRANGEMENTS
  - TRANSFER MECHANISMS
  - REGULATORY AFFAIRS
  - ETHICAL CONSIDERATIONS

- PUBLIC UNDERSTANDING
ISSUES: BASIC SCIENCE

▶ LEVELS OF SUPPORT

▶ CREATIVITY
  - CULTURE
  - INSTITUTIONAL ENVIRONMENT

▶ SCIENTIFIC INTEGRITY
ISSUES: THE GLOBALIZATION OF RESEARCH AND INNOVATION

- SECURITY AND NATIONAL INTERESTS
- TECHNO-NATIONALISTS/GLOBALISTS
- MNCs & CHINESE R&D STRENGTHS
  - THE UNIVERSITY SECTOR
  - CAS
- MNC R&D CENTERS IN CHINA
- INTERNATIONAL COLLABORATION
MNC R&D CENTERS IN CHINA

- N=750 +/- (?)
- SPEND ABOUT $2B/YEAR
- 11% OF TOTAL R&D SPENDING IN CHINA
- LEADING IN ORIGINAL PATENTS
- IMPORTANT IN CHINA’S INNOVATION ECO-SYSTEM
- CONTROVERSIES?
Rapidly Developing Ability to Win in China and Globally

GE Healthcare China R&D

- Multiple Technologies: CT, X-ray, MRI, Ultrasound, Healthcare Information Tech...
- Product Leadership – Value & Performance segments

Sourcing
- Manufacturing/Sourcing
- Sustainable Productivity Growth.
- Comprehensive Product Coverage for Global Supply Chain

R&D... Driving Growth
INTERNATIONAL COLLABORATION

▶ VERY IMPORTANT TO CHINA
▶ NEW OPPORTUNITIES WITH MLP
▶ PATTERNS
  ▪ GOVERNMENT-GOVERNMENT
  ▪ NATIONAL PLANS
  ▪ UNIVERSITIES
  ▪ CORPORATE LEVELS
  ▪ PROFESSIONAL SOCIETIES
  ▪ CO-AUTHORING
PRC NANO ’96
PRC NANO '05
US NANO ‘96
US NANO ‘05
ISSUES: GOVERNANCE

- ACCOUNTABILITY
- NATIONAL COORDINATION
- MINISTERIAL REORGANIZATION
- DISCONNECT BETWEEN MLP AND FUNDING, AND INSTITUTIONAL STABILITY
- FUTURE OF TECHNOCRATIC LEADERSHIP
CHINESE INFORMATIZATION

- LEGAL AND REGULATORY ENVIRONMENT
- TELECOM INFRASTRUCTURE
- DEVELOPING AN INNOVATIVE ICT INDUSTRY
- IMPROVING ICT HUMAN RESOURCES
THANK YOU!

SEE, ALSO: “PROJECT ON SCIENCE AND TECHNOLOGY IN US-CHINA RELATIONS”

http://china-us.uoregon.edu