IMPACT of
The Chinese Academy of Sciences (CAS)
on the National Education & Development
-------- *A Personal View*

Xiang-Sun ZHANG
Academy of Math. and Systems Science, CAS
zxs@amt.ac.cn
http://zhangroup.aporc.org

16 Feb. 2006, LUMS, Lahore

Basic Information of CAS

- 88 Institutes which can be divided into 4 categories:

  Basic Science (17)
  Life Sciences & Biotechnology (21)
  Science and Technology for Resources and the Environment (19)
  High-Technology Research and Development (31)

- >30 National Research/High-Tech Centers
- >40 National Labs
- 7 Observatory
- 4 Botanic Gardens

Basic Information of CAS (continued)

- 18 R&D Companies (>200 in total)
- Chinese University of Science and Technology
- 1 Graduate School of CAS

where all the graduate students from various institutes take their master degree causes. After two years they are back to institutes for their Ph.D studies where there are perfect research culture and environment:

- **Quality faculty**
- **Right funded projects**
- **International cooperation**
- **Research culture tradition**

If we want to discuss the impact of the CAS in China, we should introduce:

CAS's Knowledge Innovation Program

The KIP **and its inpact**

- In 1997, CAS submitted to the Party Central Committee and the State Council a report, "Strive to Build Up a National Innovation System to Meet the Era of Knowledge-Based Economy."
- In February of 1998, President Jiang Zeming gave his instruction in reply

Chinese President Meets Pakistani Chief Executive

BEIJING, January 18 (Xinhua)

- Chinese President Jiang Zemin told visiting Pakistani Chief Executive Pervez Musharaf here today that China pursues a comprehensive partnership with Pakistan.

President Jiang Zeming's Reply

"Both the knowledge-based economy and innovation consciousness are vital to the development of our country in the 21st century. The financial turmoil in Southeast Asia may slow down the development of conventional industries, but it may also provide an opportune chance for the reorganization of the industrial structure. The CAS has made some proposals, and also has a research team. I think support should be given to the Academy to work out some pilot projects, advancing one step ahead of others, in an effort to build up our own innovation system."

Social Impact of CAS' **Knowledge Innovation Program** (continued)

- The "Knowledge Innovation Strategy" now is adopted by the national leader as a development strategy of the nation.

- The 5th plenary session of the 16th Central Committee of the Communist Party of China (CPC) issued communique in Oct. 11, 2005 : China should implement the strategy of revitalizing the nation through science and education and building up the national strength by promoting talents.

Along this direction there is

"*The National Guidelines for Medium- and Long-term Plans for Science and Technology Development*"

------- Issued in 9, Feb, 2006

 China strives to be one of world science powerswww.chinaview.cn 2006-02-09 20:04:46

China maps out blueprints for S&T development BEIJING, Feb. 9 (Xinhuanet) -- China released on Thursday an ambitious plan to invigorate its scientific research and to make it one of the world's leading science powers, setting a target of 900 billion yuan (111.1 billion U.S. dollars) in annual research and development expenditure by 2020. Such huge investment will bring China level with the world's big two spenders in scientific research, the United States and Japan. More than 2,000 leading scientists and strategists took part in drafting the National Guidelines for Medium- and Long-term Plans for Science and Technology Development, which is the first of its kind since China transformed its economy into a market-oriented one. The National Guidelines said China's total R&D expenditures in 2020 should account for 2.5 percent of the gross domestic product (GDP), which is similar to that of developed economies and the scientific powers. The calculation of the 2020 GDP is based on the GDP of 8.3 trillion yuan in 2000 and a modest estimation of an average annual growth rate of 7.12 percent, which results in 36 trillion yuan, said Dr. Jia Kang, director of the Institute of Fiscal Science, which is affiliated to the Ministry of Finance. The sustained increase of spending on research and development in the coming 15 years could ensure China is one of the world's most innovative countries. The guidelines also anticipate China becoming the world's leading science power by 2050. In 2004, China's R&D expenditures took up 1.23 percent of the GDP, which is the highest among all developing countries. Meanwhile, most developed countries spent more than 2 percent of their GDP on scientific research and technological development. Huge R&D investment will ensure China leads the way in knowledge-based economies in terms of innovation and consequently economic competitiveness, Dr. Jia said. Chinese President Hu Jintao said earlier this year that China must switch from a resources-dependent to an innovation-driven economy. According to the guidelines, the government will put its state budgets as well as private funds into 68 priority subjects, 16 state key projects, 27 innovative technologies, 18 basic scientific issues and four big science exploration programs, covering energy resources, agriculture and manufacturing areas, space exploration and research on protein and nanotechnology. Xu Guanhua, minister of Science and Technology, said, "All of those are strategically important for China to ensure its national and economic security and that it makes giant strides in technology." "A big economy is not necessarily a powerful economy," Xu said. "China still lacks capability in innovation, particularly in those strategically important areas. "We would never buy or borrow the key technologies from the global leading economies." In order to sharpen China's competitiveness, the state has encouraged companies to establish top-notch R&Ds in order to be driving forces in the new-style economy. In return it promises to design new fiscal and taxation policies more conducive to innovation in the coming years. Ma Junru, a senior strategist who participated in drafting the guidelines, said, "We need to pay the upmost attention to enterprises in order to enhance our overall innovation capability." By 2020, a number of Chinese enterprises are expected to be firm fixtures in the world's top 500 thanks to their strengths in producing new ideas and products. Since the 1950s, China has adopted a total of seven medium- and long-term plans for science and technology development. With thoseplans, China developed atom bombs and man-made satellites, manned spaceships, hybrid rices and high-performance servers. Enditem

Related Story

CHINA VIEW
www.chinaview.cn

- China maps out blueprints for S&T development BEIJING, Feb. 9 (Xinhuanet) --h and development expenditure by
- The National Guidelines for Medium- and Long-term Plans for Science and Technology Development, which is the first of its kind since China transformed its economy into a market-oriented one.
- In 2004, China's R&D expenditures took up 1.23 % of the GDP, which is the highest among all developing countries. Meanwhile, most developed countries spent more than 2 % of their GDP on R&D.
- The National Guidelines said China's total R&D expenditures in 2020 should account for 2.5 % of the GDP. Huge R&D investment will ensure China leads the way in knowledge-based economies in terms of innovation and consequently economic competitiveness.
- Chinese President Hu Jintao said earlier this year that China must switch from a resources-dependent to an innovation-driven economy.

CHINA VIEW
www.chinaview.cn

- According to the guidelines, the government will put its state budgets as well as private funds into
  - 68 priority subjects,
  - 16 state key projects,
  - 27 innovative technologies,
  - 18 basic scientific issues and
  - four big science exploration programs, covering energy resources, agriculture and manufacturing areas, space exploration and research on protein and nanotechnology.

- Related Story

To do further discussion I will take the Academy of Mathematics and Systems Science (AMSS) as an example since I have been a faculty member of AMSS for 40 years and had positions:

- Full research professor from 1986
- Director (1992-1998) of the Institute of Applied Mathematics, one of the initiating unit of AMSS
- Executive Deputy Director of AMSS from 1998 to 2002

A Case Study----- The Academy of Math. and Syst. Science (AMSS)

- Builded in 1950, named Institute of Math. (IOM)
- IOM split up in 1979 into three institutes:
  - Institute of Math. (IOM),
  - Institute of Applied Math. (IAM), and
  - Institute of Systems Science (ISS)
- The three institutes plus the Institute of Computational Mathematics and Scientific/ Engineering Computing (formed in 1995) were merged into the Academy of Math. and Systems Sciences (AMSS) in 1998

Attributes that make AMSS similar to a Research University:

- Graduate program only, similar to

  JAIST---Japanese Advanced Institute of Science and Technology

  KAIST--- Korean Advanced Institute of Science and Technology

- Quality faculty 18 CAS members/60 professors : (<) 400 Ph.D students
- Strategic planning for research project Promptly starting significant research branches which will lead great impact on general university education
- Flexible and adjustable mechanism To accommodate AMSS to the newly raising scientific problems

Strategic planning for research project
Examples in the history of AMSS

- While ensuring a coordinated development of major aspects of mathematical research, the Institute of Mathematics prioritized the development of newly emerged math branches in the world, which were closely related to the national economy.
- In 1956, an Operations Research Group was set up (later an OR Division in 1958);
- In 1961, a Division of Control Theory was established.
- These two branches later played a leading role in the education of universities in the nation.

From OR Research to OR Education

- The first OR division was founded in Institute of Mechanics in 1956 leaded by Prof. Qian Xuesen (*Ph.D., Goddard Professor, California Institute of Technology*) and Prof. Xu Guozhi (*Ph.D., Kansas University, Professor, Maryland University*).
- The second OR division was set up in Institute of Math.
- These two divisions merged into one division in 1960 in the Institute of Mathematics.
- In 1961, this division organized a series of specialized courses in OR in Chinese University of Science and Technology, which was the first time in China that a university offeres a systematic education in OR.

From OR Research to OR Education

- During 80s many universities and institutes started to set up OR degrees (MS and Ph.D) with their professors once trained/visited in IOM/AMSS
- OR researchers in the IOM/AMSS have been taking the leading positions of the Operations Research Society of China, which was set up in 1980.
- ……

Flexible and adjustable mechanism

--- Keeping the faculty active and innovative

- *An ideal mode for faculty recruiting of a research-oriented unit*
  - Non-permanent position/visiting position
  - Evaluation/``come and go''
- *A lesson of AMSS in 1998*
  - Institute of Math. → 3 institutes to meet a development stage of science for its diversity in 70's
  - 4 institutes merged to AMSS by the need of interdisciplinary research trend in 90's
  - professors in the 4 Institutes competed for 60 professor positions
- *The current policy in AMSS*
  - 4 years appointment contract
  - Age limitation for promotion

Flexible and adjustable mechanism

--- Easy to reorganize the personnel to explore the new appearing research branches

- This is one of the main reasons of combining the 4 institutes in 1998. According to the next 10 years' strategic plan of CAS, there will be several "platforms" to serve the cooperation between the CAS institutes
- AMSS now has the capacity to group scientists in its 4 institutes to initiate a new area research:
  - Center of Bioinformatics, 1999
  - Information Security Research Center, 1999
  - Center for Decision Making Under Uncertainty
  - Center for Financial Engineering and Risk Management
  - Complex Systems Research Center ***and more***

Conclusion

--- *The basic research part of the CAS (if we look it as a research university) played a key role in the nation's advanced education at the earlier development stage of our country (1950-1965, 1978-1990) due to the limited resource.*

--- *Now the mission and organization of the CAS is tending to fit both the high-technology innovation and the basic research.*

Conclusion *(continued)*

--- *Even in the basic research plan there is more concern given to the interdisciplinary research and problem-oriented research.*

--- *As for problem-oriented research, the problems are those the nation face in its rapid development.*

Thank you!

http://zhangroup.aporc.org