National and Regional Contexts:
Priorities, Capabilities, and Strategies

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China's 12th 5-year plan (Government of the People's Republic of China, 2011) articulates strategies for scientific development that include (i) enhancing capabilities in indigenous research; (ii) promoting innovation in science, technology, and administration; and (iii) improved education and training of students. The country wishes to become known for innovation. Graduate education and research are pivotal to achieving these goals and in recent years, China has seen an unprecedented increase in the number of higher education institutes and in allocation of funding for research. Indeed, government research funds in Mainland China have been increasing at an annual rate of more than 20% (Shi & Rao, 2010) with a concomitant increase in the number of graduate students. The sequel to this increase is that it has positively impacted the country's capabilities to undertake cutting-edge research and train graduate students. However, this increase has also brought challenges. Against this background, this paper identifies capabilities, challenges, risks and priorities in research and graduate education in China.

Capabilities for Research and Graduate Education in China

Mainland China

The latest statistics released by the Ministry of Education (MoE) in Mainland China (Yu, 2011) revealed that in 2011 there were 755 institutions offering master's and doctoral degrees. These institutions include 481 colleges and universities, as well as 274 research institutes. A total of 560,200 graduate students (65,600 doctoral students and 494,600 master's students) secured admission to graduate programs in 2011, an increase of 22,000 students (4.09%) compared to the previous year. The total number of graduate students was 1,645,800, an increase of 107,400 (6.98%) from 2010. This impressive increase in the number of graduate students is unprecedented in China's higher education system.

In addition, in 2011, there were 5,010 research institutes with 218,596 staff members and 233,265 graduate students. The government expenditure on research in higher education was approximately 22.8 billion Yuan (US$ 3.74 billion). The MoE funded 125,513 projects as detailed in Table 1. *paper continues next page*

Table 1. Research institutes by research field for higher education institutions in 2011

Research field	Number of institutions	Number of staff	Number of graduate students	Funds in thousand US$ (thousand Yuan)	Number of projects
Material science	352	19,048	20,900	354,388 (2,165,315)	10,541
Electronics and communications technologies	302	14,120	20,884	328,101 (2,004,699)	8,184
Mechanical engineering	321	13,952	15,052	276,014 (1,686,448)	7,804
Biology	351	14,023	17,168	265,279 (1,620,858)	8,851
Chemical engineering	180	7,252	10,096	154,278 (942,637)	4,930
Chinese medicine	299	8,293	4,657	45,229 (276,352)	3,764
Others	3,205	141,908	144,508	3,694,939 (22,576,079)	121,749
Total	5,010	218,596	233,265	3,740,168 (22,852,431)	125,513

Source: Compilation of Statistics from Science and Technology of Higher Education Institutes, 2011

The establishment of National and State Key Laboratories has enhanced the quality and quantity of research in Mainland China. The State Key Laboratory Scheme was initiated in 1984 to support respected scientists and scholars to conduct seminal research to further support China's technological and economic development. These laboratories are of the highest international standards. Currently, there are nine national laboratories, namely the Beijing National Laboratory for Molecular Sciences, Beijing National Laboratory for Condensed Matter Physics, Beijing National Laboratory for Condensed Matter Physics, Tsinghua National Laboratory for Information Science and Technology, Beijing Electron Positron Collider (Chinese Academy of Sciences, 2013), Hefei National Laboratory for Physical Sciences at the Microscale, National Synchrotron Radiation Laboratory, Wuhan National Laboratory for Optoelectronics, and the Institute of Modern Physics; and another ten national laboratories are under construction. There were 103 state key laboratories in 2010 (*List of State Key Laboratories*, 2010); these are universities and private sector laboratories that currently receive funding and administrative support from the Central Government. The State Key Laboratories cover different areas of research, such as ocean engineering, chemistry, medicine, physics, mathematics, materials science, and structural engineering. Currently, there are around 300 state key laboratories in China. It should be noted that there are State Key Laboratories outside Mainland China, and there are 16 in Hong Kong with five at The University of Hong Kong.

Table 2 shows the research funding allocated to the highest ranked universities in China by the MoE. Peking University, Tsinghua University, and Zhejiang University are ranked as the top three universities in Mainland China and Tsinghua University had more than 1,400 scientific and technological research projects funded by MOE in 2011 (Tsinghua University, 2013). In 2013, Tsinghua University had 311 research institutions/centers including one national laboratory for Information Science and Technology, one national large research infrastructure for Protein Science, two national large-scale scientific instrument centers, and thirteen State Key laboratories.

Table 2. Ranking of research funds for major higher education institutions in 2011

Ranking	**University**	**Funds in thousand US$ (thousand Yuan)**
1	Peking University	431,344 (2,635,511)
2	Tsinghua University	395,968 (2,419,366)
3	Zhejiang University	370,343 (2,262,794)
4	Shanghai Jiaotong University	342,288 (1,981,402)
5	Fudan University	250,761 (1,532,150)
6	China Agricultural University	219,396 (1,340,507)
7	Huazhong University of Science and Technology	199,377 (1,218,196)
8	Northwestern Polytechnical University	190,449 (1,163,644)
9	Beijing Institute of Technology	189,966 (1,160,692)
10	Sun Yet-sen University	181,706 (1,110,222)

Source: Compilation of Statistics from Science and Technology of Higher Education Institutes, 2011

The main research fields in Peking University (also known as Beida) are Humanities, Social Sciences, and the Natural Science. In 2011, it received funds of over US$ 431 million (2.64 billion Yuan) from the MoE, which is clearly an indication of the strong momentum for the university to move forward in research and higher education in Mainland China. Peking University has one National Laboratory in the area of molecular sciences and ten State Key Laboratories (Peking University 2013).

Hong Kong

The Research Grants Council (RGC) provides the majority of funding for research in the eight local government-funded universities in Hong Kong. The annual budget was around US$ 121 million (HK$ 940 million) in 2011. The allocation of earmarked research grants covered the Theme-based Research Scheme, General Research Fund, Collaborative Research Fund, Joint Research Schemes and other schemes. Approximately 68% of the RGC's budget was allocated to the General Research Fund and a total of US$ 83 million (HK$ 641 million) was allocated to fund 801 research projects out of 2,572 applications in 2011 (Chin, 2012).

Of the eight government-funded universities, The University of Hong Kong received the largest amount, of around US$ 20.7 million (HK$ 161 million). It should be noted that the allocation of research funds by the Hong Kong Government from the RGC was only 28% of the annual funding allocation to Peking University by the MoE.

Needs and Benefits

China has enjoyed unprecedented economic growth over the past few decades and this has fueled the development of higher education and research. At the same time, there has been an emphasis on moving away from traditional modes of "chalk-and-talk" instruction to approaches to learning and teaching that foster creativity and innovation. The higher education institutions (HEIs) are now becoming the main force of the national science and technology invention system in Mainland China and several high-tech enterprise clusters have been built near some of the HEIs.

Challenges and Risks

Shi and Rao (2010) have analyzed the research funding distribution system and the research culture in China. They have pointed out that the committees appointed by bureaucrats in the funding agencies determine the guidelines for funding allocation. As a result, a significant proportion of researchers in Mainland China spend a lot of time building relationships with committee members and other people involved in the funding allocation, and spend less time on research and training students. However, progress has been made in reforming the management systems and education provision systems of the HEIs (*The 9th 5-Year Plan for China's Educational Development and the Development Outline by 2010,* 2009). The central government now works together with the local governments to strengthen the higher education system and the funding distribution system in Mainland China.

Priorities

The efforts in science and technology research in HEIs, as stated in the MOE 9th 5-year plan for China's educational development (2009), "have been further strengthened with a remarkable increase of input to it and a smooth transferring of outcomes." Due to the fast economic growth in China, there is a large demand for science and technology research. The Central Government continues to invest in HEIs. Therefore, the quality of research and graduate education will continue to improve in Mainland China.

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