Institutional Development in China's Science & Technology

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by

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It is clear that China has been moving on many fronts to boost science and technology and to stimulate innovation. Preferential policies on taxation, investment, technology transfer, and scientific awards have been established to propel technological innovation. China has encouraged direct foreign investment in manufacturing and R&D through special rules on taxation and land acquisition. Foreign experts and Chinese nationals form abroad are being sought to meet the needs of growing high-tech enterprises.

Although China enjoys one of the fastest-growing economies in the world at this time, it was noted by Prof. Xie that China knows it can not compete in all areas of technology development. Thus, it is

focusing its limited resources on a small number of advanced technologies with strategic relevance to economic growth and infrastructure improvement. These technologies include, of course, electronics, supercomputers, telecommunications, avionics, GPS, and nanotech, the last of which is to receive special attention in the next Five Year Plan during 2006-2010. This policy of strategic focus is entirely appropriate for at least the next 10 years of technological evolution in China. As I will describe later, it is simply not feasible for China to attempt to compete with countries such as Japan and the United States in all areas of science and technology.

Concurrent with infrastructure development, which will require one or more decades to upgrade significantly, is the development of management expertise and leadership principles, so often overlooked by economists as a contributing factor in competitiveness. I greatly admire the leadership and management training being done here at the University of Maryland for Provincial executives from many areas of China. Indeed, I have enjoyed lecturing to several hundred of these executives over the past 4 years about R&D, innovation, leadership, and change. As I will explain later, far more business management programs will be needed in China, not only for finance, marketing, accounting, budgeting, human resources, and operations, but for management of the scientific and technical enterprise, which is changing rapidly in the U.S. and elsewhere. Universities will play a key role in China's transformation from a planned economy to a market-driven economy based on knowledge and skills. The more

than 1,000 universities in China will have to educate a new generation of managers, to develop and disseminate new knowledge from basic research, to foster improved knowledge transfer to the commercial sector, and carry on lifelong and distance learning. University administrators will also need new skills to cover these added responsibilities as well as the long list of traditional ones. A wise move would be to hire some experienced university administrators from abroad to bring new ideas as well as the required management skills to the Chinese academic environment.

Several years ago, I spoke at the 4th International Conference on Manufacturing Technology, convened by the Chiang Industrial Charity Foundation in Hong Kong, on "Integration of Manufacturing with R&D and Marketing for Competitiveness." The point of my remarks was to stress the critical importance of integrating the efforts of these corporate functions, because emphasizing one without the others would be quite unfortunate. Studies by Prof. Edward W. Roberts of MIT have shown that the two most important keys for success in commercializing technology are the integration of technology planning with business planning, and the utilization of external resources. Procter & Gamble, for example, with its "connect and develop "strategy, aspires to have at least half of its new technology come from external sources, that is other firms as well as universities and government labs, within 5 years.

I mentioned earlier that the self-reliance policy of China has shifted, appropriately, to the mastering and utilization of key technologies developed abroad that are essential to competitiveness. Chinese R&D investment has nearly doubled in the past 5 years, but is still just over 1% of its GDP. On the basis of purchasing power parity, however, it ranks quite high in the world. The goal of raising the ratio to 1.5% by 2005 is ambitious because a rapid and continuous expansion of the scientific enterprise, unless carefully controlled and managed with clear goals and metrics for success, can also be unproductive. I was impressed by the similarities between R&D investment by Chinese enterprises and U.S. industry, with both at around 63% of total national effort. Whereas Chinese R&D investment allocates 78% for development, it is only 61% in the U.S. Applied research accounts for 17% of the total effort in China and 21% in the U.S. The largest difference is in basic research, with 5% being spent in China and 18% in the U.S. Japan, for example, allocates 12% of its total R&D investment for basic research, so China eventually needs to consider placing more emphasis on long-term, high-risk type of research.

The May 2004 *MIT Technology Review* includes a global invention map that indicates the national innovative capacity of most nations in the world. The article indicates that only two dozen countries have significant levels of invention and innovation, activities that correlate closely with rising standards of living. The national innovative capacity measures a country's potential to produce commercially

relevant innovation, based on patents, percentage of scientists and engineers, innovation policies, number and size of technology clusters, or hot spots, degree of connectivity between these clusters, and other institutions, GDP per capita, business competitiveness, sophistication of marketing, and relationship between pay and productivity. As expected, the U.S. ranks #1, followed by Finland, the UK, Japan, and Germany. China is ranked #40, followed by Chile, Russia, and India.

As noted earlier, the role of management expertise is critical for success in all of the factors on which national innovative capacity is based. The role of close coordination between functions within enterprises was also noted, but equally important is coordination of government economic policies to stimulate risk-taking in R&D and investment in innovation. The association I was with for 27 years, the Industrial Research Institute, or IRI, worked hard to bring about an understanding of industry's needs by government policy makers and laboratory directors. These efforts were highly successful and can be emulated by a counterpart of IRI in China some time in the future. IRI has held 3 forums for member-company laboratory directors in China, beginning in 2000, to lay the groundwork for such an organization, which could help provide training for future leaders of technology and innovation in China. In conclusion, I would say that China is embarked on a new era of economic development that will meet numerous challenges and disruptions, but I see a drive and will to achieve long-term economic viability and competitiveness.