

## Can China Innovate?

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[About the author:

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The CEIBS Centre on China Innovation was established in 2011 with support from four Dutch multinational corporations: Shell, Phillips, AkzoNobel and DSM. The purpose of the Centre is to undertake research on how Chinese companies are moving from imitation to fundamental innovation; what multinationals can learn from them about improving their innovation processes in China; and how MNEs can best use China as a platform for global innovations and to improve their innovation processes company-wide.]

### **Summary:**

*Western firms' preconceptions about China's slowness in radical innovation are misplaced. They must prepare for a tsunami of competition from China-based multinationals, which increasingly see the markets of the developed world as their targets. Multinationals must actively participate in innovation in China with the aim of using China as a platform for global innovations.*

### **Business Innovation**

*Can China innovate?* This is perhaps the most important issue for aspiring Chinese multinationals, foreign companies operating in China and the Chinese government. My answer to the question is *yes*. But I need to qualify the answer by considering China's innovation capacity in the context of its recent development and relative to other countries.

Business innovations differ in terms of their scope and impact on the existing state of affairs. At one extreme is *incremental* innovation (improvements to an existing innovation, which are gradual in their effect); at the other extreme is *disruptive* or *radical* innovation, where the impact is transformative. These two kinds of innovation are manifested in practice in three forms: as a product or service; as a process; or as a business model.

### **China's Innovative Capacity**

Let's first look at China's basic scientific capacity, on which much of innovation is based.

One measure of China's scientific capacity is investment in R&D by *government*. China's reported public expenditure on R&D as a percentage of GDP has risen from 0.3% of GDP in 1996 to 0.4% in 2009. US public expenditure on R&D has fluctuated between 0.6% of GDP and 0.7% and for the EU, between 0.65% and 0.7%. So China has been under-investing in public R&D as compared with the US and Europe (although because of the rapid growth in China's economy the absolute value has increased dramatically). Yet despite the funding limitation, China has developed a number of excellent universities and research institutions undertaking research of high quality research.

Another measure of the inputs is *business* R&D spending. Here we look at business R&D spending by China as a share of the total business R&D spending in all the OECD countries plus China (not yet had OECD member). In 2008, the US accounted for 38% of the total business spending on R&D within that group of countries. China accounted for 11%, Japan 16% and the EU 24%<sup>1</sup>. That year, China's GDP as a share of the GDP of that same grouping (the OECD plus China) was 17% and the US share was 29%. So the US was over-spending on business R&D relative to its economic importance and China was under-spending. But in 1998, just 10 years earlier, China's share of business spending on R&D was only 1.9% of the total, so its relative importance has increased 5- fold during that period.

China's largest companies are not yet leaders in many of their sectors in terms of innovation investment. Among the top 1000 companies in the world in 2009 ranked by R&D investment, only three Chinese companies were in the top ranks in their respective industries: China Railway Construction and PetroChina ranked first in the world in their sectors, and China Coal Energy No. 3. In the ICT sector,

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<sup>1</sup> Thomas Barlow, *Between the Eagle and the Dragon*, United States Studies Centre, University of Sydney, 2011.

two companies which are relatively well known outside China, Huawei and Lenovo, ranked 14<sup>th</sup> and 68<sup>th</sup>.

Now let us look at some measures of *output*. Scientific journal publications are one measure, because a country's technological capability is in part derived from scientific research. Of course that's only one factor in innovation, but the starting point for developing a country's long-term innovative capacity is scientific research.

When we compare the share of articles in scientific journals (published globally in the top scientific journals) the share held by the US and the EU has been declining over the years. In 2007, the US published about 27% of the global total in top scientific journals. The EU -- 27 countries -- published about 32%, China and Japan each about 7%. So there's still a big gap in scientific output, but China's share has been growing fast, whereas the share of the other major economic entities has been declining.

There are also marked differences across particular fields. In Chemistry and Physics, China has a higher share of publications than its average over all fields. It is publishing about 14% of the world's scientific articles in those fields, almost at the level of the US, which is publishing about 17%. China has also grown rapidly in Mathematics, Engineering and Computer Sciences, where it is publishing some 12% of the world total, compared with the US at about 22%.

Where China has not been growing rapidly is in the journals that publish research in biological, medical and life sciences, including biotechnology.

Another measure of innovative output is patents. Chinese companies and SOEs have become very active in lodging patent applications—over 300,000 in 2009. But the majority of that activity— about 95% - is patenting solely *within* China. If we look at the percentage of PCT (Patent Cooperation Treaty) patent applications, the percentage shares of both the US and the EU have been falling over time. In contrast, the Chinese share has been rising, as has that of Japan. Yet in 2008, the US and Europe each still accounted for some 30% of the international patent applications in that year, whereas China had just 5% <sup>2</sup>. So despite the fact that Chinese entities are lodging a lot of patent applications, very few of them are for *international* patents.

This is important because international patents are an indicator of intellectual capital with potentially global commercial applications. So there's a big challenge for Chinese private companies and SOEs to increase the percentage of

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<sup>2</sup> Barlow, *cited above*

patents which have international quality and applicability. However, as China becomes more concerned about intellectual property protection, it seems very likely that Chinese enterprises will seek to do so.

### **Chinese Business Innovation**

Given the evidence regarding innovative capacity, it is not surprising that China has not yet become renowned for radical, disruptive, business innovations. Rather, its innovative focus has been on incremental adaptations to existing technologies, initially often by copying, but today more and more by genuine innovation.

What is interesting about this innovation is that it is driven by the marketplace. It is argued by Breznitz and Murphree, who studied the Chinese ICT industries, that most of China's business innovation is happening in the private sector rather than in state-owned enterprises, and it is driven by small to medium sized companies working to fill market needs<sup>3</sup>. These companies have become essential players in integrated global supply chains and are forced to keep close to the forefront of incremental innovation in their business in order to remain competitive. And because the markets are moving so quickly, they have to be nimble to adapt technology and business models to respond quickly. This Darwinian struggle for survival has driven their capacity to innovate.

Quite a few Chinese companies have also created products or services which are designed for under-served segments of the Chinese market. One of the ways they achieve this is by cutting out unnecessary cost and unwanted features so as to serve price-sensitive segments of the Chinese market, a process of incremental innovation some researchers call "cost innovation"<sup>4</sup>. This is a very promising aspect of innovation in China: these companies may not yet be producing radical products, but they have developed an understanding of the Chinese marketplace and the innovative capacity to respond effectively.

### **China and Radical Innovation**

There are fewer Chinese companies that are producing radical innovations and they're not alone in that respect. Most Western companies have difficulty in producing radical innovations, and that issue is well explained by Clayton Christensen in his book *The Innovator's Dilemma*<sup>5</sup>.

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<sup>3</sup> Dan Breznitz and Michael Murphree. *Run of the Red Queen*. Yale University Press, 2011

<sup>4</sup> Ming Zeng and Peter J. Williamson. *Dragons at Your Door: How Chinese Cost Innovation Is Disrupting Global Competition*. Harvard Business School Press, 2007.

<sup>5</sup> Clayton Christensen, *cited above*

The development of radical and innovative capacity takes time and it often begins with incremental innovation. Firms have to learn how to be innovative and this happens through exposure to demanding markets and competition. This is the position of those Chinese companies which have become successful as major players in the ICT industry.

There are also a number of smaller companies in China that are quite advanced in their innovative capacity to develop new products. Two examples I've studied recently are in the nanotechnology field, based in Suzhou. One of these firms, SVG Optronics, uses nanotechnology to create very thin films which provide holograms for patterns that can be printed onto such things as identity cards, which become impossible to copy. The Chinese identity card, based on this technology, is said to be more sophisticated than the drivers' license used in Europe or the United States.

The second company, Suzhou Nano-Micro BioTech Co., employs nanotechnology to produce micro- particles of uniform size and shape in the range from 5 nanometers to 1000 microns for certain sophisticated applications, such as pharmaceuticals, medical diagnosis, flat panel displays, enzyme catalysis, and cosmetics. While these innovations haven't yet turned markets upside down, these companies are successful domestic and international suppliers and their innovations seem significantly more than incremental.

An example of innovation in the business model is 4 Dimensions - Johnson, a company in Beijing, which produces specialised vehicles for demanding applications, such as armoured trucks for transporting cash. This firm produces these vehicles by a process of "mass customisation" and has become a leading company in this business. It exports a limited range of standardised body components in knocked-down panels from China and assembles them into complete vehicles in European subsidiaries acquired in the UK and Germany. This company's innovative business model has turned on its head the conventional view of China as the place for final assembly.

While some in the West dismiss Chinese innovation, in fact there is a lot happening in China, in varying degrees and in many places, including second-tier cities. Many firms will fail, but in the Darwinian fight for success in their home and international markets, some will emerge as radical innovators.

Another force stimulating innovation in Chinese companies is their outward expansion. Successes in the domestic market are now providing the base for Chinese companies in other sectors to gain access to foreign markets, brand names and innovative expertise. As a consequence, hundreds of Chinese-owned

R&D centres have been set up overseas by acquisition, joint venture, or green-fields investment.

These firms are participating in innovative ecosystems and advanced markets where ideas are generated and where sophisticated products appear earlier than in China's domestic market. Lenovo, Huawei, Haier and Mindray are examples of Chinese firms which, while not yet household names, are becoming insiders in foreign markets and working to strengthen their innovative capacity.

### **China as a crucible of innovation for Western multinationals**

Many multinationals are adapting their technologies, processes and business models to benefit from China's growth. And this has led them to see China as a test-bed where capable scientists and engineers can develop technologies and business models for global deployment, at reasonable cost. As of now, there are few documented examples of such "reverse innovation". GE's low-priced cardiac monitor and ultrasound machine are the best known. But as firms increasingly succeed in responding to the particular challenges dealing with large and relatively frugal market segments, the lessons of innovation in products, processes and business models will increasingly provide a basis for expansion to the developed world.

For multinational enterprises, the challenge is to adapt the learning gained from this market to opportunities in the rest of the world. There is not a great deal of time to gain these insights. Chinese firms and those from other rapidly developing economies, such as India and Brazil, increasingly look for growth in the traditional strongholds of the developed multinationals. It would be a serious mistake to underestimate the abilities of these companies to innovate and eventually to be disruptive forces in those markets. To remain indifferent to this challenge is to risk being engulfed by coming tsunami of innovation flowing out of the rapidly developing world.