

RARE EARTH INNOVATION: THE SILENT SHIFT TO CHINA

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There has been much ado made about jobs in industrialized nations being lost to cheaper labor in developing countries overseas. Indeed, globalization is having a drastic affect on industrialized nations, as many western societies are shifting away from manufacturing economies toward those based on the service industry. While job losses have become front page news, something that has not been part of the public conversation is the loss of innovation.

Peter Drucker defined innovation for the corporate world as “the specific tool of entrepreneurs, the means by which they exploit change as an opportunity for a different business or a different service.” It is critical for companies to innovate in order to take advantage of new opportunities. Pushing technology beyond its current limits allows for increased productivity, and can result in a standard of living boost for a given society.

The long-held perception is that the US (and other industrialized nations) has a technological edge over developing nations that will somehow be retained forever. In 2002, President Bush stated, “We’ll continue to fight a guerilla war with conventional means, because we’re the best in the world with high technology.” (emphasis mine).

Rare earth elements (REE) are at the center of high technology and the next wave of world innovation. Much of modern society depends on rare earths through their use in computers, lasers, telecommunications, iPods, medical technology, and the military applications, etc.

If the US loses its competitive edge in rare earth innovation, it may well lose its edge in the coming generation of technological advance. A recent study by Brian J. Fifarek, Francisco Veloso, and Cliff I. Davidson entitled “Offshoring Technology Innovation: A Case Study of Rare-earth Technology” offers compelling evidence—through the study of patents—that we should question some common perceptions about US technological superiority. This study provides very persuasive arguments that demand further discussion of the power shift involving both offshoring and the place of REE in our society.

The study shows that rare earth patent applications by US firms are in decline compared to the rest of the world. Their results support the theory that research and development (R&D) may decrease at home as the vital segments of an industry are offshored.

China has had a plan to enhance their advantage in rare earth since soon after REE were discovered there in the mid 1980s. Chinese leadership (including Deng Xiaoping and Jiang Zemin) has long emphasized the importance of REE for the future of China. Using lower labor costs, less environmental restrictions, and highly concentrated resources, China was able to wildly increase production and bring the world to its doorstep with low cost REE. The top US producer, Molycorp's Mountain Pass mine, could no longer compete and faced environmental issues. As the world market experienced this shift from the US toward China, the study points out that US firms were forced to work more closely with Chinese firms—facing new challenges of communication across geographic separation, cultural disparity, and multiple time zones.

China currently produces approximately 95% of the world's rare earths, and they have made it more difficult to obtain REE outside of their country. Since 2003, China has created export quotas, eliminated VAT rebate on exports, initiated production quotas and imposed a 10% export tariff on REE. This has required foreign firms to establish a presence on location in China. The Chinese have intentionally (and successfully) created an atmosphere of reliance on China as the all-encompassing center for REE.

Innovation and rare earth research are increasing rapidly in China. Mr. Fifarek describes the rare earth research center at Baotou as “an innovative environment that is growing.” There are 1000-2000 dedicated scientists researching rare earths, and a large body of research is being provided by Chinese sources. There are 3 or 4 university centers in China devoted to the study of rare earths. These measures are all designed to keep China at the forefront of REE production, materials, technology, and innovation. As the study states, “As manufacturing moves overseas, it is inevitable that both engineering work and R&D will follow.”

The Chinese have rapidly accelerated their number of rare earth patents. This shift may become even more dramatic as China further restricts the outflow of its resources. As it is, non-Chinese firms are now faced with ever-increasing pressure to relocate closer to the Chinese REE resource. Compared to the US, China is gaining a clear advantage in the pace of developing patented technology. As there is no strategy in the US to reverse this process, we may assume that this trend will continue and possibly accelerate. The implications for future innovation may be both surprising and potentially devastating for the US and other industrialized nations.

The US may continue to lose ground if we don't re-spark a national focus on rare earth technology. The study reveals that universities may discontinue research on technology that experiences a decreased interest by local firms because of offshoring.

The prime example of this in the US is the loss of Iowa State's Rare-earth Information Center (RIC), which closed in 2002 due to a shift in funding from rare earths to pig research. This is an excellent illustration of the difference between US and Chinese

strategies. The US does not have a clearly-defined national initiative to guide the study of rare earth – so regional institutions such as Iowa State are forced to transfer funds to research more directly related to their local economy (pork). This is not to say that US funds are not directed toward rare earth research—there are government grants given to universities to study various rare earth uses—but there is no comprehensive or guiding plan.

A vivid example of the power shift in the REE industry can be found in the magnet industry. The US played a critical role in the discovery and development of rare earth magnets starting in 1966 with SmCO₅ magnets. General Electric, Bell Labs, Raytheon, and General Motors were among the key companies developing this technology. In 1983 NdFeB magnets were introduced as a cheaper and more powerful solution for the magnet industry. The new NdFeB magnets were rapidly accepted by the marketplace. Magnequench was formed in the 1980s by GM to take full advantage of the new technology. In 2000 Magnequench completed construction of a research park in North Carolina. However, in that same year it also opened a plant in China. By 2004, Magnequench closed all of its US facilities and moved operations to China and Singapore.

The study further reinforces the decline of US influence in the fast-growing rare earth magnet industry:

“Informal conversations with one firm representative revealed that removing manufacturing from the US has also led to the removal of over 90% of domestic R&D activities on rare-earth permanent magnet materials. More importantly, the knowledge for producing NdFeB magnets within the US has been lost. US based manufacturers can no longer compete with the quality of NdFeB magnets produced in China or Japan.”

The REE magnet industry is slated to grow at over 12% per annum through 2010, with China being best-positioned to benefit from this growth.

When I asked Mr. Fifarek what has surprised him most in his study of rare earths he replied, “The fact that no one is really looking at this issue of how offshoring affects innovation”. We take for granted that jobs will be lost overseas. The discovery of new REE resources in China was bound to increase competition in the rare earth industry. But it seems that the US has been caught completely flat-footed in regards to the transfer of innovation overseas in one of the future’s most important areas of technological development. Indeed, there is very little awareness of the problem or its severity.

In the last fifteen years there has been a power shift from a US-dominated REE industry to a Chinese dominated one. This supremacy now extends to most of the vertical market—from production to innovation to end product.

All is not lost, but the US must initiate a clear plan to gain and retain a technological edge in the research and development of REE. When I spoke with Mr. Veloso (one of the study’s co-authors), he stressed that all is not “doom and gloom” with US research in REE. While the magnet industry has left the US, others—such as catalysts—have stayed. Mr. Veloso stated that we must “reinforce specialized research” regarding rare earths, as there are still areas that we can lead.

The US must identify strategic areas of rare earth innovation and provide funding to the firms and universities that can do the research. We need a comprehensive strategy to guide the development of the next generation of rare earth technology.

For over a decade, China has had an unambiguous policy in place to dominate the rare earth industry. The US needs to recognize its loss of innovation and develop a strategic plan of its own.

Link to Study:

[http://www.andrew.cmu.edu/user/bfifarek/Fifarek.%20Veloso.%20Davidson%20\(2006\)%20Offshoring%20Technology%20Innovation.pdf](http://www.andrew.cmu.edu/user/bfifarek/Fifarek.%20Veloso.%20Davidson%20(2006)%20Offshoring%20Technology%20Innovation.pdf)

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