

Managing knowledge for radical product innovation development in China

Successful radical product innovation sets out to develop new products that serve a previously unmet market need¹. Examples of radical product innovations include the development of Teflon in the 1940s, containers for shipping products in the 1950s, Pilkington's process for making flat glass in the 1960s, integrated circuit chips and personal computers for home use in the 1970s, the compact disc in the 1980s, and the Smart Car in the 1990s.

The highly competitive business markets of today heighten the need for firms to pursue strategies that enable them to develop and/or maintain radical product innovations. Indeed, fast product life cycles create the potential to quickly erode a firm's market position. Apple's radical product innovation in the smartphone category, resulting in its market leading iPhone and the fall from grace of the mobile phone giant Nokia, provides just one example of this.

Apple's ability to manage, maintain and create knowledge has revolved around its model for sustaining a broad technology base. For the last 35 years it has followed a vertical integration model, allowing it to control both its end products and the component parts². However, the recent successes of Apple reflect its ability to understand its core competence in synchronisation software development as a driver for its development of radical technologies. That is how the iPhone came about. Before the iPhone, Apple had already been developing synchronised software in its iTunes software for use on its popular iPods. The application of synchronisation software to the iPhone gave it greater capability to access information³. This transformed the landscape for smartphones – they became a 'must have' item. Apple's ability to leverage this core competence and maintain competitive advantage has allowed it to set the pace in mobile technologies.

Radical product innovations have for some time been the domain of Western firms. And product development in China has continued to rely heavily on the adoption of foreign-developed technologies and innovations⁴. However, the Global Financial Crisis prompted China to face a new era in market development. With the marked slowdown of consumption in the West, coupled with increases in domestic wages, China can no longer rely on exports of manufactured products to sustain its growth. To satisfy the growing sophistication of consumers in China, and in global markets, Chinese firms need to develop a culture for product innovation⁵.

In 2006 China set a target for technological progress to drive more than 60% of economic growth by 2020⁶. A recent report by KPMG identifies that within China the current focus of government, domestic companies, and global corporations is clearly shifting to greater development of R&D. The 12th Five Year Plan on National Intellectual Property Development (2011-2015) and the 12th Five Year Plan for Patent Examination place a focus on increasing protection of property rights and have increased confidence in R&D development in China, particularly for foreign-invested firms. Whilst Chinese firms focus on raising their R&D capabilities to meet local and global consumers,

¹ <http://www.asianbc.dk/Findings/Fast-and-frequent/Radical-or-incremental-innovation.aspx>

² <https://knowledge.wharton.upenn.edu/article/vertical-integration-works-for-apple-but-it-wont-for-everyone/>

³ http://en.wikipedia.org/wiki/History_of_the_iPhone

⁴ KPMG, (2013) Innovation in China: New Frontier for Global R&D, China 360, Issue No.11, August. Available from: <http://www.kpmg.com/cn/en/issuesandinsights/articlespublications/newsletters/china-360/pages/china-360-issue11-201308-new-frontier-for-global-r-and-d.aspx>

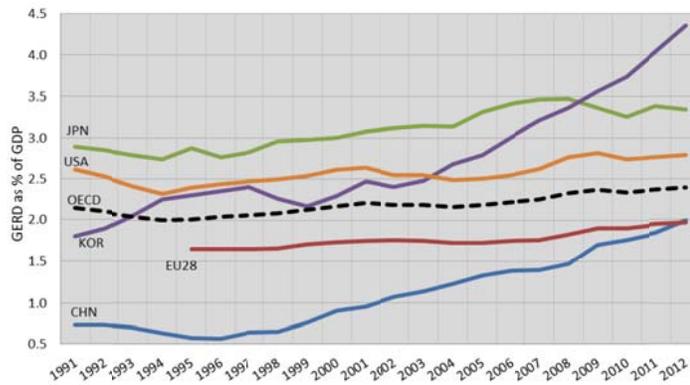
⁵ <http://www.theglobalist.com/innovation-and-management-in-china-germany-united-states/>

⁶ http://hal.inria.fr/docs/00/68/63/89/PDF/FMSH-WP-2012-07_Fabre-Grumbach.pdf

multinational companies are increasingly locating key R&D activities in China to get closer to the expanding market.

The effects have been positive for China. KPMG suggests it may not be a surprise to see China soon become the world’s global R&D investment leader⁷. Based on current rates of growth and investment, Battelle forecasts that China’s total funding of R&D could surpass that of the U.S. in 2022⁸. It will be interesting to see how this develops. Recent figures show that during 2010 and 2011, patent filings in the US respectively grew from 490,000 to 500,000. Over the same period, patent filings in China grew from 400,000 to 525,000⁹. Also, China has now moved ahead of the EU in its proportion of gross domestic expenditure spent on research and development (GERD)¹⁰.

RISING R&D INTENSITY – CHINA EDGES AHEAD OF THE EU



Source: www.oecd.org/sti/msti.htm

With the growing emphasis on technological advancement in the China market, firms will be working on raising their understanding in areas related to radical product innovation development. In their study of radical product development strategy, Professor Kevin Zheng Zhou and Professor Caroline Bingxin Li¹¹ identify that there is a lack of research on how firms can influence the development of radical product innovation through combining their knowledge base with ways to integrate knowledge. A study they conduct draws together past research on how the combination of a firm’s knowledge base and their mechanism for integrating knowledge affect the firm’s development of radical product innovation. In particular, the study focuses on technology firms located in China, where foreign firms now make up a large part of the market.

⁷ KPMG, (2013) Innovation in China: New Frontier for Global R&D, China 360, Issue No.11, August. Available from: <http://www.kpmg.com/cn/en/issuesandinsights/articlespublications/newsletters/china-360/pages/china-360-issue11-201308-new-frontier-for-global-r-and-d.aspx>

⁸ http://www.battelle.org/docs/tpp/2014_global_rd_funding_forecast.pdf?sfvrsn=4

⁹ Garcia Herrero, Alicia, and Fielding Chen. ‘Innovation: Where does China stand?’ *Economic Watch*, June 8, 2012. BBVA. http://www.bbva.com/KETD/fbin/mult/120608_ChinaWatch_Innovation_EN_tcm346-332809.pdf?ts=2082013, cited in KPMG, (2013) Innovation in China: New Frontier for Global R&D, China 360, Issue No.11, August. Available from: <http://www.kpmg.com/cn/en/issuesandinsights/articlespublications/newsletters/china-360/pages/china-360-issue11-201308-new-frontier-for-global-r-and-d.aspx>

¹⁰ <http://www.oecd.org/sti/msti.htm>

¹¹ Zhou Zheng, Kevin, and Li Bingxin, Caroline. (2012) How Knowledge Affects Radical Innovation: Knowledge Base, Market Knowledge Acquisition, and Internal Knowledge Sharing, *Strategic Management Journal*, pp.1090-1102.

Currently, there are approximately 1,600 R&D centres in China. About 1,300 of these are foreign owned – in the year 2000 this figure was only 120¹². MNEs with R&D facilities in China include Pepsi, with its largest R&D centre outside of the US located in Shanghai. BASF houses 10 R&D centres in Shanghai¹³. Other examples of MNEs with R&D facilities in China include Intel, Samsung, Sony, IBM, Microsoft, and Hewlett-Packard. As Professors Zhou and Li note, the growing presence of foreign firms is placing pressure on local firms to become more proactive in their development of radical product technologies.

A recent study by Booz finds that R&D spend by local Chinese companies continues to surge. However, the study also finds that the top 10 R&D spenders were not the most innovative companies. In terms of innovation and R&D spend, there also continues to be a large gap between Chinese and Western firms. Although companies like China National Petroleum spent \$2.291 billion (less than 1-2 percent of its sales) and ZTE Corp the fifth largest telecom equipment maker spent \$1.399 billion (10% of its sales¹⁴), in terms of R&D spend globally they ranked 64th and 100th, respectively¹⁵. The largest global spender on R&D was Volkswagen with \$11.4 billion, followed by Samsung with \$10.4 billion. Interestingly, the most innovative company was Apple Inc., with an R&D spend of \$3.4 billion or 3% of revenues¹⁶ (43rd in terms of global R&D spend). Samsung was the 3th most innovative company and Volkswagen did not make the top 10¹⁷. Clearly, effective spend on R&D can be more important than the absolute or comparative spend of firms. Radical product development is normally an expensive exercise. As Albert Einstein¹⁸ expressed:

“If at first the idea is not absurd, then there will be no hope for it.”

As Professors Zhou and Li identify, past research finds that creativity in new product development revolves around the firm’s ability to manage, maintain, and create knowledge. More current research suggests that it is the firm’s knowledge base which provides it with leverage in developing radical product innovations. Firms may possess a broad knowledge base, such as might be experienced in Huawei, GE, and Samsung, or a deep knowledge base such as might be experienced by companies involved in microchip development, solar cell development¹⁹, or oil and gas exploration and production, for example. Firms may further develop their knowledge base through sharing knowledge within the firm or acquiring knowledge from the market place. However, Professors Zhou and Li also identify that within past research “conflicting views exist about whether knowledge breadth (broad knowledge) and depth (deep knowledge) actually benefit radical innovation”²⁰. Their research therefore places a focus on how external market knowledge acquisition and internal knowledge sharing may condition the firm’s use of its knowledge base for radical innovation. They propose that the roles of knowledge breadth and depth in the development

¹² <http://www.businesschina.org.sg/en.php/resources/news/317/1>

¹³ KPMG, (2013) Innovation in China: New Frontier for Global R&D, China 360, Issue No.11, August. Available from: <http://www.kpmg.com/cn/en/issuesandinsights/articlespublications/newsletters/china-360/pages/china-360-issue11-201308-new-frontier-for-global-r-and-d.aspx>

¹⁴ http://www.zte.com.cn/en/about/investor_relations/corporate_report/annual_report/201404/P020140408599365909862.pdf

¹⁵ http://www.chinaipr.gov.cn/newsarticle/news/headlines/201310/1781674_1.html

¹⁶ http://investor.apple.com/secfiling.cfm?filingid=1193125-13-416534&cik=#D590790D10K_HTM_TOC590790_8

¹⁷ http://www.strategyand.pwc.com/media/file/Strategyand_2013-Global-Innovation-1000-Study-Navigating-the-Digital-Future.pdf

¹⁸ http://www.innovationexcellence.com/blog/2011/08/16/25-inspiring-innovation-quotes/#at_pco=smlwn-1.0&at_si=53ba49e1da0cfce8&at_ab=per-2&at_pos=0&at_tot=1

¹⁹ Furr, NR, Cavaretta, F, and Garg, S. (2011) The Dangers of Deep Knowledge: New Ventures in the Solar Industry, presented at the Annual Meeting of the Academy of Management, San Antonio, TX.

²⁰ Zhou Zheng, Kevin, and Li Bingxin, Caroline. (2012) How Knowledge Affects Radical Innovation: Knowledge Base, Market Knowledge Acquisition, and Internal Knowledge Sharing, *Strategic Management Journal*, p.1097.

of radical product innovation critically depend on external and internal knowledge integration systems of the firm.

Two studies are conducted. The first study includes 354 participants from 177 firms located in the Yangtze River Delta in China, which contains the provinces of Shanghai, Jiangsu, and Zhejiang. It is the most developed area in China and experienced a growth rate of 10.1% in 2012²¹. Multinationals such as Intel, Microsoft, Dow, and GE have set up their R&D centres in the region. The research is further strengthened by a second study which includes 68 interviews with managers from high tech firms located in the three most developed areas in China – the Yangtze River Delta, Beijing District, and Guangdong.

There are two major findings. The first finding suggests that internal knowledge sharing is the driver for achieving radical innovation in firms that possess a broad knowledge base. Knowledge sharing within the firm creates bridges across its functional units and encourages the firm to develop new ways to combine its range of knowledge applications for achieving unique product advances. Firms with a broad knowledge base such as Microsoft, Huawei, and Samsung, for example will therefore benefit more from developing their internal knowledge capabilities, than seeking to develop their capabilities to acquire market knowledge. Interestingly, Apple initially sought to develop smartphone technology in cooperation with Motorola, however, they found the partnership limiting and reverted back to their broad knowledge base to arrive at a better product in their iconic iPhone.

The second finding suggests acquisition of knowledge from the market is the driver for achieving radical innovation in firms that possess a deep knowledge base. Firm's with a deep knowledge base, include such companies as Intel and their production of semiconductor chips, Thorlabs production of photonic tools and systems²², and China's Yingli Green Energy, known as 'Yingli Solar'²³ the largest global producer of photovoltaic modules. The research suggests that market knowledge tends to complement deep knowledge of the firm and substitutes for the possible development of broad knowledge to achieve radical innovations in product development. One example is the Intel China Research Centre which is currently focused on communications technology and microprocessor technology. Intel believes the combination of both holds the key to advancement of Intel's future products. To drive its developments in these areas Intel China has developed working relationships with R&D centres located in the USA, Russia, and India. Cooperative relationships have also been developed with leading technology companies and universities in China, including the Chinese Academy of Science. Areas of collaboration include compiler technology, audio visual speech recognition systems, and device and circuit research²⁴.

Interestingly, past studies have identified that market knowledge acquisition is a major driver for the development of radical product innovation. However, the findings here warn that this is only partly correct. Where a firm possesses a broad or diverse knowledge base, acquiring additional market knowledge may actually prove to be counterproductive, such as in the example of Apple. On

²¹ Hong Kong Trade Development Council, (2012) *Jiangsu: Market Profile*. Available from: <<http://china-trade-research.hktdc.com/business-news/article/Fast-Facts/Jiangsu-Market-Profile/ff/en/1/1X000000/1X06BV87.htm>>. [13 January 2014].

²² <http://www.thorlabs.us/PressReleases.cfm?ReleaseID=79>; <http://www.laserfocusworld.com/articles/2014/04/thorlabs-opens-fiber-optic-manufacturing-and-r-d-center-in-montreal-canada.html>

²³ <http://ir.yinglisolar.com/phoenix.zhtml?c=213018&p=irol-IRHome>

²⁴ <http://www3.intel.com/cd/corporate/icrc/apac/eng/167066.htm>

the other hand, when firms possess deep knowledge in specific fields, internal knowledge sharing tends to reinforce expertise and routines that already exist within the firm. This can result in resistance within the firm to develop radical innovations, which reside outside the scope of its current deep knowledge base.

The research by Professors Zhou and Li has important implications for managers of high tech firms wishing to develop or further develop their firm's capability to create radical product innovations. As past research finds, the firm's ability to manage, maintain, and create knowledge are most important. However, as their research identifies, managing knowledge resources for the development of radical innovation tends to relate to the fit between the firm's existing knowledge base and the way it integrates knowledge. Specifically, managers must first examine the knowledge base they already have and identify whether the advantages that exist across its nature and content reflect a position of depth or breadth in knowledge. Next, managers should adjust their knowledge integration strategies and mechanisms, to fit with their firm's existing knowledge base. Last, to maximise the benefits from the firm's already accumulated knowledge, for the purpose of enhancing the prospects for developing radical innovations, a firm with a broad knowledge base should consider strengthening its knowledge sharing processes and routines. On the other hand, a firm which possesses a deep knowledge base should consider placing greater focus on building and refining internal processes associated with acquiring and integrating intelligence from the market.

The findings from Professor Zhou and Li's research auger well for firms wishing to raise their capabilities for the development of radical product innovations. The findings are particularly important to Chinese, and Western firms located in China. China's environment continues to become more conducive for the development of radical product R&D. As Professor Zhou suggests, "firms focused on developing radical product innovations that meet the needs of China's expanding sophisticated consumer base should reap attractive rewards".