China: Moving from Imitation to Innovation

ETM520 Research Paper

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Abstract

The findings in the paper are an illustration or indication that China is moving from being an imitator to being an innovator. The analysis in the paper has been focused on identifying the direction for China and addressing some of the key challenges. This project examines three areas impacted by China's move towards innovation:

1. *The Chinese electronic manufacturing industry*
2. *The impact of China's workforce on innovation*
3. *China's software industry and copyright issues that are impacting its growth*

The findings are based on data and literature research and interviews. The primary empirical data has been collected through a limited number of short semi-structured interviews with executives from Chinese manufacturing companies. The companies have some level of globalization of business through exports, international manufacturing, and research and development activities.

1 Introduction

China is known for being a low cost manufacturer. Many western companies have invested in China and partnered with Chinese companies because of the low cost of putting raw materials into the production process; they see China as a low cost supply base. Chinese companies have learned from their western partners to greatly improve their manufacturing processes and the quality of their products. When we look at market share around the world, and the growth of China's manufacturing, it is clear that China is a global manufacturing leader.

- China's worldwide manufacturing market share:
  1. 50% of Cameras
  2. 30% of air conditions and televisions
  3. 25% of washing machines
  4. 20% of refrigerators
- One Chinese private company manufactures 40% of all microwaves sold in Europe
- 70% of world's metal cigarette lighters are produced in Wenzhou, in Eastern China [1]

We have identified that China has historically been a manufacturer or a low cost producer. They have excelled as an imitator, a manufacturer of goods at the commodity level. The success has come in low-margin industries where China has been able to take advantage of their relatively low cost of labor and materials. Industries such as home appliances, consumer electronics, garments, toys, and the commodity end of high tech products such as computers and telecommunications. [2]

While the success in these areas allowed for rapid development, the fundamental limitations of the imitation strategy could clearly be seen. The markets where China had competed were typically low-margin. The firms were not able to realize the greater returns associated with innovative products and they were

trapped in the imitator position, not being able to leapfrog into the position of innovator. [2]

There are many factors that have caused Chinese firms to be limited to an imitation role. The country has relied too heavily on technology and processes developed in the west. [3] Other factors include the inability of firms to absorb the technologies being imitated, lack of copyright protection, government regulations and policies, and lack of qualified R&D personnel. [2]

Despite the struggles, innovation has certainly come to China. The Chinese government recognized the need for true radical innovation and policies have been put in place to help drive towards this goal. In 2006, Chinese President Hu Jintao urged scientists to "*work towards an innovation-oriented nation*". He continued, "*Science and technology, especially strategic high technology, is increasingly becoming the decisive force in economic and social development and the focus of competition in comprehensive national strength*." [4] These quotes help us to identify why innovation is so important to China. China is an ambitious, rapidly developing country, but the imitation strategy has its limitations. The transition to innovation is essential in order for continued growth to take place.

A compilation of three major patent databases, US, EU, and World Intellectual Property Organization (WIPO) shows that China is strategically pursuing an increase in its intellectual property rights (IPR) portfolio. Even though this is only an indicator, this increase shows a move in the direction of becoming an innovator rather than an imitator. (See Figure 1-1)

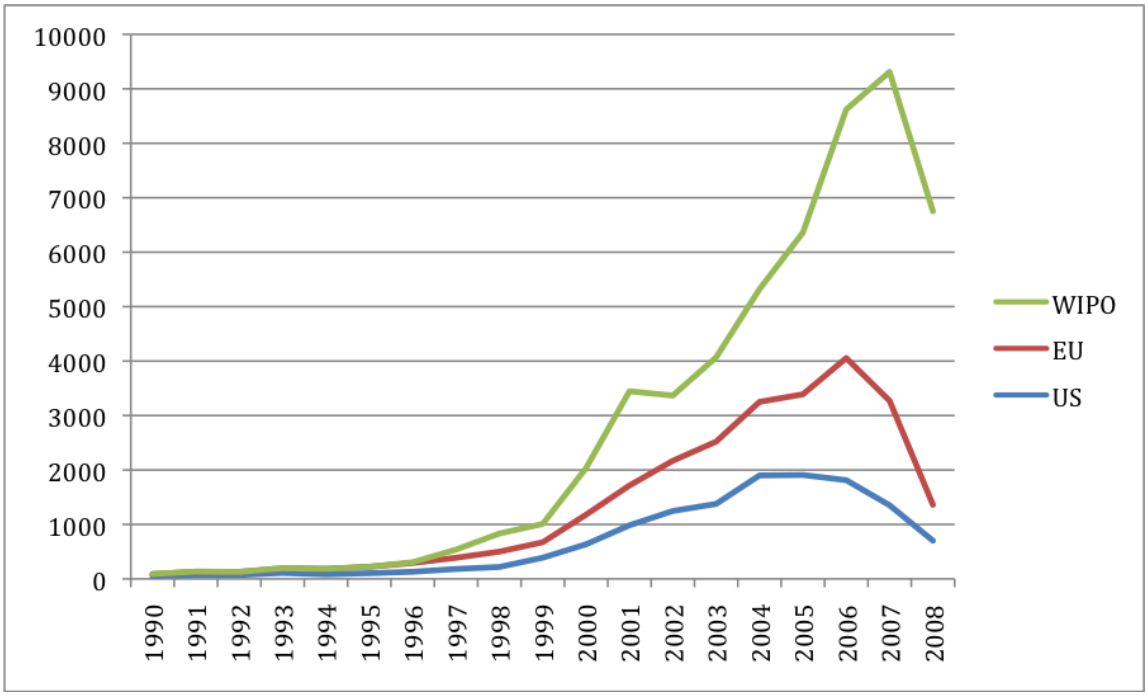

Figure 1-1 Chinese patent submittal trend [5]

Substantial increase in patent submittals can be credited to a change in Chinese policy and its institution of Free Trade Zones (FTZ). Established in 1992, FTZ allowed foreign enterprises to develop a Chinese presence and avoid paying many import / export tariffs. FTZ were extremely successfully, but were limited to export areas of the country which limited expansion. In 1995, the Chinese government implemented High-Technology Development Zones (HTDZ) to focus on attracting foreign investment in technology production, research and scientific centers. HTDZ are located throughout the country except for rural western province regions. [6]

With the policy changes in the early 80s and 90s, China has made an attempt to curb intellectual property rights (IPR) infringement practices, but has been moderately successful. The 2001 entry into the World Trade Organization (WTO), China adopted and implemented many unilateral property rights protections. Even though in agreement with such protections, China still finds it difficult to implement and enforce such protections. Despite China's inability to enforce appropriate IPR

protections, Chinese patents have significantly grown throughout the last one and half decades.

As China moves to becoming an innovator, this paper will examine the Chinese electronic manufacturing industry, the impact of innovation on China's workforce, China's software industry and copyright issues that are impacting its growth, and also identify potential challenges that China will face on the road to innovation.

2 Innovation in China's Electronics Manufacturing Industry

In this section of the paper, we will look at three cases of Chinese consumer electronics manufacturers. These are companies that have traditionally filled the role of manufacturer for western corporations, but are increasing their own innovative activities. Executives from these firms were interviewed to find out about the role of innovation in the Chinese electronics manufacturing industry. The companies are described in Table 2-1.

	Company 1	Company 2	Company 3
Description of Company	Designer and Manufacturer of OEM and ODM products for audio applications	Manufacturer of acoustic products with design center in Shenzhen and factories in Southern China	Former government factory now public company, designer and manufacturer of electronic products
Age of Company	13 years	20 Years	58 Years
Title of Interviewee(s)	General Manager	Chairman and CTO	Vice President of Business Development

Table 2-1: Three Chinese Companies Interviewed about Innovation

Information from the interviews is combined with research of recent publications to illustrate the current state of innovation in the Chinese electronics manufacturing industry.

2.1 Research and Design

A great deal of research and design (R&D) work is taking place in Chinese companies today. All of the companies interviewed are actively involved in R&D to differing degrees. Company 1, being a relatively young, company has always maintained a certain level of R&D. They now see design capabilities as central to their success, "*if we only do purely manufacturing we will have no business*." This strategic direction has not always been the case. Company 2 is transitioning from being a manufacturer whose designs were directed by its western customers to a company who offers electronic, mechanical, acoustic and wireless design services. Company 3 has seen a huge increase in design work for 2009 and they expect to release several innovative products, which they have designed, to market in 2010.

Current sources reflect the companies discussed above. In a study of Chinese telecommunications companies, one researcher found that, "*innovation capability developed by the domestic telecom-equipment manufacturers has been a driving force for the catching up with the MNCs* [multi-national corporations]." [7] Telecommunications is a very competitive industry that requires high levels of R&D investment. It is filled with multi-national giants such as Cisco, Ericsson, Motorola and Nokia. Considering this level of competition, it is even more impressive when we see that the Chinese companies are able to make an impact in this industry both domestically and internationally. To give an idea of the level of R&D investment that these Chinese telecom companies are making, "*ZTE, Huawei, Datang, and GDT had 42, 46, 30, and 54% of their workforce devoted to R&D in 2002, respectively*." [7]

Over the last two decades, many Chinese electronics firms have grown to become global players in their markets, such as the success of Huawei in telecommunications. Lenovo has become a major player in the PC market since acquiring IBM's PC computing division. This acquisition included international research and design facilities. The Haier Group is the fifth largest producer of electronic appliances in the world. They design and manufacture everything from large white goods to TVs and DVD players. [8]

Research defines a linear progression towards innovation, with increasing involvement in R&D. This progression starts with cheap labor assembly followed by Original Equipment Manufacturing (OEM) where a company only manufactures a product. It then moves to Original Design Manufacturing ODM where a product is designed in conjunction with an innovative partner and then manufactured. The final step is Original Brand-Name Manufacturing where a company defines, designs, manufactures and markets its own products. [7] It is interesting to note that China's rapid development is causing an overlap of all of these stages (see Figure 2-2). Both Company 1 and Company 3 are working in the OEM, ODM, and OBM areas simultaneously. While learning and imitating in one area, they are innovating in another area. Retaining flexibility and balance in these different manufacturing models has proven to be successful for Chinese manufacturers who work with multinational corporations.

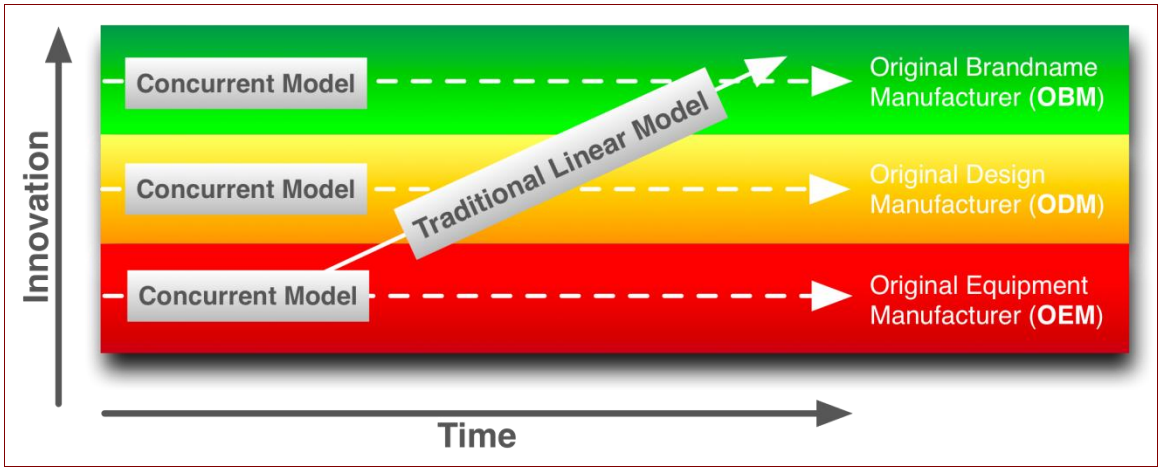

Figure 2-2: Progression of Manufacturing Models

2.2 New Technology and Radical Innovation

An article on Stanford's FSI website states, "*total R&D spending nearly tripled over the past decade, reaching 1.3% of GDP in 2005, even while GDP doubled. China is now ranked third worldwide in overall R&D spending (after the US and Japan), with targets to increase spending to 2% of GDP by 2010."* [9] While all of these numbers show a significant investment in R&D, it is important to note that the majority of this spending is in new product development, not research. This is a key distinction because long-term radical innovation requires more than investment in original design, but also investment into research of new technology. One source noted that, "*three-quarters of R&D is in development, rather than research*." [10]

In the case of our three companies, we can see that the need for research has been recognized and the companies are pursuing new technologies. Company 1 is researching energy saving and high efficiency products. Company 3 is also active in research of new technology. Company 2 takes a different approach to new technology. While recognizing the importance of new technology, they also recognize the limitations of their own research capabilities. Their strategy involves collaboration with design partners and innovation through the transfer of technology from other industries, for example bringing new developments from toys and automotive electronics to the audio electronics sector.

2.3 New Marketplace

One of the key drivers of innovation in China is the rapidly growing Chinese marketplace. As China's economy continues to expand, there is an increased demand for new and innovative products. According to a consumer study, Chinese consumers are increasingly willing to try new products. Another survey shows that Chinese consumers show a great interest in purchasing innovative products. [11]

The companies that we interview have recognized the opportunities associated with this growing marketplace. Company 1 has its own brand of products that it develops specifically for the Chinese market. They recognize China as one of the major markets in the world and their sales volumes in China are gradually increasing. The challenge is dealing with the differences in performance and form-factor that are required by the Chinese market as the culture and preferences can be quite different from the West. Company 3 has recently purchased a locally recognized brand in order to take advantage of the local market. While they will retain the organization and distribution chain of this newly acquired brand, they will be applying a new technology roadmap to the products. Company 2 is hesitant to enter the Chinese market and they believe that Chinese consumers are still more focused on necessities such as homes and automobiles. They do continue to monitor the Chinese consumer market so that they will be prepared when the market is ready for the type of products that they are manufacturing.

This domestic marketplace can be a strong competitive advantage for Chinese manufacturers. Research shows that two-thirds of the Chinese personal computer market is owned by Chinese companies. These high domestic volumes allow for cost reduction of products worldwide. [8]

2.4 Impact of the Recession on Innovation

The 2008-2009 global recession has had a huge impact on companies around the world. Despite China's growth throughout the recession period, Chinese companies who rely on exports have suffered along with western companies. With Chinese manufacturers supplying the world with goods, a crisis of overproduction was inevitable. There is however a positive side to the recession for innovative companies. While companies who rely on low-margin imitation based products will certainly suffer, companies with an innovative edge can strengthen their position.

The financial crisis can be seen as an opportunity for Chinese manufacturers to transform from being the world's factory to being an independent manufacturing industry. [12] Innovation is in it's infancy in China. Most Chinese brands do not have international recognition and their products do not necessarily have higher quality or unique technology to differentiate them. But with continued investment in research and design, this paradigm will certainly shift and in the long term we can expect to see more Chinese brands in the western marketplace. At the same time, companies who fail to adequately invest in R&D will continue to loose business.

In the case of Company 2, financial hardships began long before the 2008/2009 global recession. The increasing cost of labor and materials combined with financial pressures brought about by the exchange rate have been impacting the company for the last couple of years. However, these challenges have not caused a reduction of investment in innovation. They recognize the importance of original design capability and continue to pursue this path forward.

2.5 Communication

Communication in Chinese manufacturing firms is an enormous topic for a complex nation and culture. As, Tornatzky and Fleischer (1990) suggest, informal linkages and communication among the employees, the quality of human resources, top management's leadership behavior and the amount of internal slack resources would significantly influence the emergence or even adoption of technological innovation. [13]

Knowledge transfer is essential to be a successful innovator. In order to achieve this, an effective communication and interaction between functional groups is necessary. This is much more evident in R&D. Most R&D teams in China are diversified and are typically composed of three groups. [14] Local graduates make up the majority of the R&D staff. Western expatriates and global Chinese comprise

the other two groups. In our context, 'global Chinese' is a generic term for these subgroups of Chinese people working for foreign R&D: Mainland Chinese returnees with educational and working experiences abroad, Chinese from greater China (Taiwan and Hong Kong), and overseas-born ethnic Chinese. Due to this diversity there is a multilayered difference between these subgroups that come from various educational backgrounds, different working styles and perceptions.

The companies defined in our case study recognize these differences in their work force and are taking steps to tap this knowledge. In case of Company 1, the local Chinese management constitutes about 40% of the total management force and overseas personnel manage the rest. All their local Chinese managers have experience working in western companies, so this allows them to have a consistency in their thinking and mindset. Company 2 appreciates the diversity in their R&D teams and sees it as a beneficial tool which leads to an increase in creativity, and innovative ideas and which ultimately results in challenging the status quo. They encourage the use of social networking sites such as Myspace and Facebook as a platform to exchange their thoughts. They also recognize the need for a formal platform to communicate, which might result in knowledge transfer and ultimately knowledge management.

Having an effective communication tool is as important as having an innovative idea itself. Due to the vastness and various languages being used in China, it is essential for the companies to adopt a common pathway of language to transfer these innovative ideas. From our interview with Company 1, we see that most of their employees were born on or after 1970. Due to the historical context of China at the time, most of the Chinese employees adopted mandarin as a common official language. Common communication methods are something in which all companies need to look into in terms of having an effective policy for transferring innovative ideas.

3 Innovation and the Chinese Workforce

Several indicators show, as mentioned in previous sections, that China is moving from imitation to innovation, either academically or industrially. For example: the number of SCI papers that have been published in China is a good indicator of innovative progress China has made in academia. (see figure 3-1)

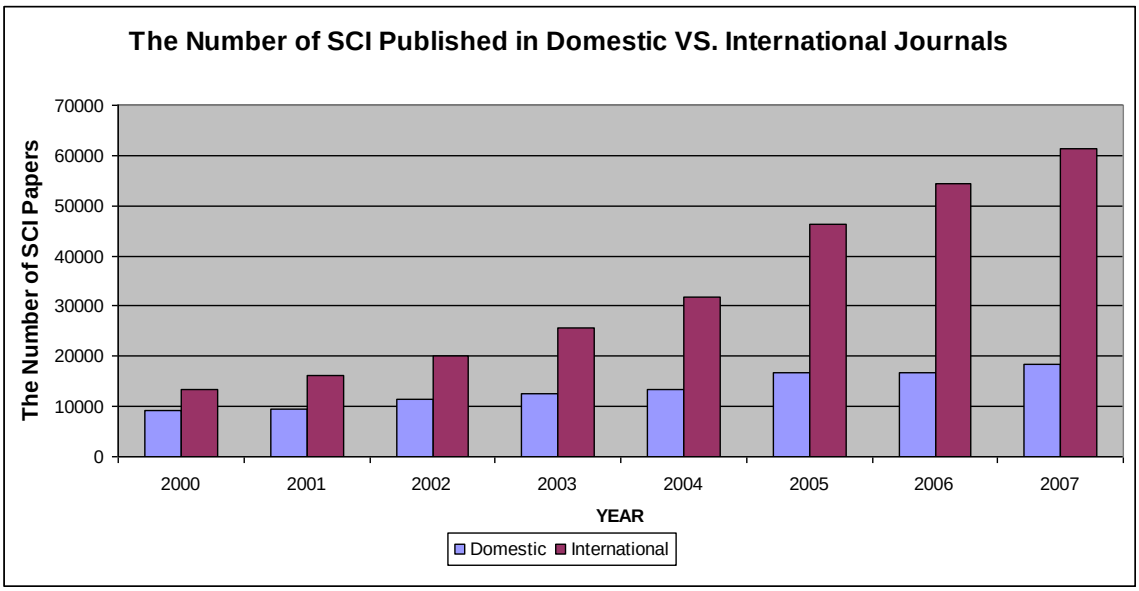

Figure 3-1: Number of SCI Published in Domestic vs International Journals [16]

And industrially, Huawei has been identified as "the pioneer of disruptive innovation." It has built several research institutes globally which are located in India, US, Sweden, Russia and domestically, Beijing, Shanghai, Nanjing, etc. Out of the 62,000 employees 46% are engaged in R&D and they have submitted roughly 19,000 patents. [17]

3.1 Domestic Education and the Returning Workforce

Complex factors contribute to the innovation process, these factors include workforce level, macroeconomics and socio-political. [18] However, in this context the focus will be on the workforce and associated issues. Workforce issues can be

broken down in two aspects: the domestic education level and also returning workforce.

Existing full time employees spend much of their free time improving their skill sets through vocational education and obtaining various industry licenses or certifications. In our interviews, Company 3 identifies, *"the entry-level workers are spending much of their free time in study. "*

Additionally, the number of college graduates as seen in Figure 3-2, has grown substantially as access to universities has been extended to the general public.

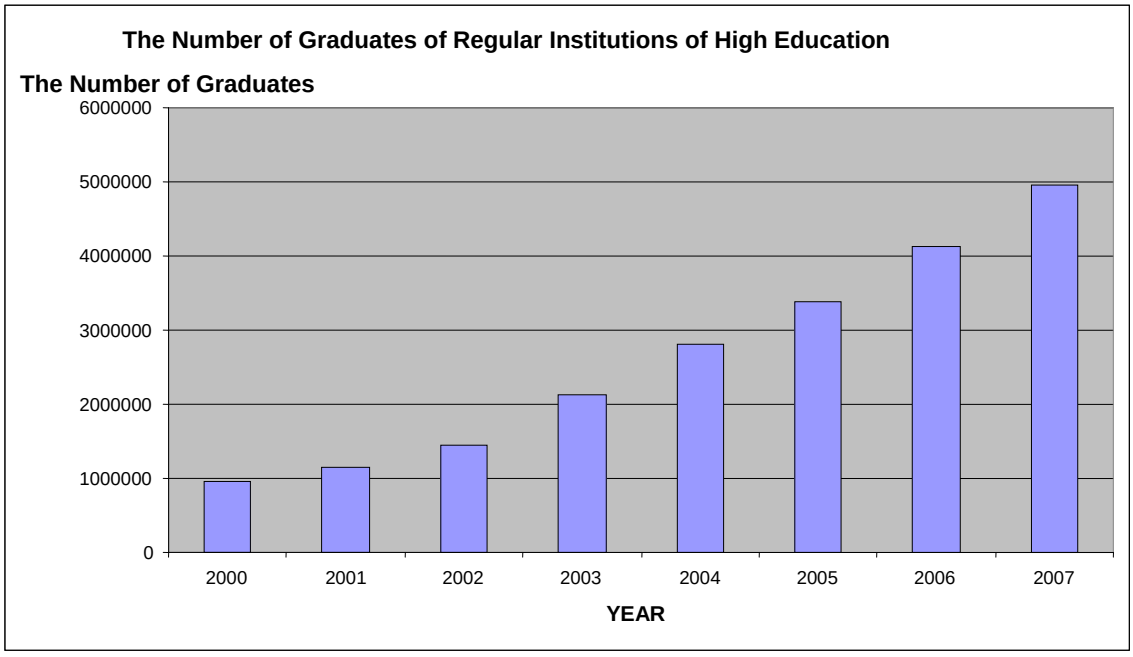

Figure 3-2: Number of Graduates from Higher Education Intuitions [16]

Even though there has been record numbers of college graduates, fresh graduates don't have the necessary work experience to bridge the gap between theoretical knowledge and real world applications. However, the increased number of higher educated graduates and new professionals will accelerate the innovation

process by providing the knowledge and know-how they acquire. This acceleration has been recognized: local industry and universities have been making significant efforts to shrink this knowledge/practical gap. Specifically, China Mobile sponsored an Individual Innovation Competition for university students [19] and Baidu Company supported a National Undergraduate Rural Information Innovation Contest in 2008. [20]

As many nations face negative growth caused by the global recession of 2008-2009, the Chinese economy continues to expand which enables China to attract talent from abroad. This minority group of people has been regarded as a significant power in shaping the future of China. Both professionals and fresh graduates who worked or were educated overseas are nicknamed 'sea-turtles'. [21] As foreign capital continues to increase from $407.15 billion in 2000 to $835.21 billion in 2007, the number of professionals and students who are working abroad and migrating back to China is extensively increasing. [22] Studying and working abroad provides them with unique insight and experience. The influx of capital and qualified professionals created an environment for returnees to develop their own businesses. According to the statistics, in the last three decades, there have been 390,000 (28%) returnees of the roughly 1,390,000 accounted for and 17,000 technology oriented enterprises were returnee-owned. In addition, there are roughly 40 companies listed on NASDAQ, which are mostly owned by returnees who have worked abroad. [16] Further, there are many indications that technology based returnees have a competitive advantage in entrepreneurship.

3.2 Managerial and Technical Workers

Tang Jun, former CEO of Microsoft China Co. Ltd, made the following statement: "*Professional managers are not simply a group of employees with*

relatively higher salaries, but they are innovative specialists equipped with advanced management theories and rich practical experiences to lead their enterprises".

Indeed, a returnee must possess several entrepreneurial characteristics to be successful. Defining innovative "out-of-the-box" managerial concepts, being able to attract capital and associated talent, keeping abreast with the latest business developments and preparing for international cooperation all define a successful returnee. These characteristics can be broken down into three elements:

1. Technology professionals

A returnee must be aware of the latest technological developments occurring around the world. Majority of returning CEOs originated from technologically advanced industries such as IT, financial, and multi-media. Returnees that possess similar work experience to Silicon Valley or Wall Street have a more competitive advantage.

2. Capital

Subsets of returnees are financial experts who are able to attract foreign capital. The Chinese venture capital industry is relatively new and requires expertise that has solid financial operation capabilities and also a sharp perspective to guide for future growth.

3. Advanced managerial model

Returnees must possess the knowledge to manage technology in their respective industries. China's rapid development has created a demand for qualified technology managers who can incorporate and transfer modern managerial models.

However, successful returnees are not successful simply because they are returnees, the expanding Chinese market, the transfer of managerial concepts from

abroad, but the collective experience and the implementation of their intellectual capital.

The migration of returnees is a relatively new phenomenon, and still needs a series of policies and regulations to formalize it. From a technology management perspective, several problems can be identified. Returnees have to be cautious about technology and not to infringe on the intellectual property of their respective employer. To avoid such problems, the Chinese government must implement and enforce IPR rules and regulations. As identified by Yuan Dongjian, "*Returness should keep eye on the game rules of intellectual property*". [21]

Other challenges include keeping and utilizing talented returnees and their inherited technologies to avoid unnecessary lawsuits. These potential problems need comprehensive efforts from government, individual, and organizations. Although most western organizations are usually efficient at localization, "*western style of human resourcing is taking hold here as perks are needed to keep talent*". [Quote from interview of Company 3]

4 Copyright and the Chinese software industry

With many parallels to the electronic manufacturing industry, the Chinese software industry faces many of the same challenges. Rampant copyright infringement and piracy continues to plague China's ability to outgrow its negative perceptions and propel itself as an innovator. A detailed look into the software industry illustrates the key issues that China has faced when dealing with copyright infringements.

Research by the Business Software Alliance shows that total world software loss associated with piracy totaled a staggering $53 billion dollars in 2008 where $15.2 billion is attributed to Asia-Pacific alone. The same study showed the 80% of

all software installed on Chinese computers were estimated to be illegitimate or pirated versions. [23] A comparison of 20% and 17% piracy rates in the United States and the UK respectively. Even though a large percentage, China has made progress to lower the number of pirated software being distributed within its borders; in 2004 the software piracy rate was a staggering 90%. This drop in distributed pirated software can be credited to policy implementation; in 2006 China's Ministry of Information Industry (MII) ruled that all computers manufactured within the Chinese borders should have authorized operating systems installed prior to being sold to the consumer eliminating the need for the consumer to make that additional investment. [24]

China still ranks in the top 25 of the largest software piracy capital in the world, and the problems extend to its own software development and intellectual property. China has seen the second largest monetary loss of $6.6 Billion as compared to the United States of $9.1 billion from pirated software.[25] China's inability to address software piracy locally is hampering its internal competiveness in the software market. Furthermore, China is witnessing the monetary impact of its own information technology industry as it pertains to copyright infringement and software piracy around the world.

When interviewed Bill Gates stated, that China still needs to make more progress in its adoption of proper licensing practices. And that he expects this process would take roughly 10 years to implement and enforce such policies to be within adequate levels. "*But as long as there is year-by-year progress, it holds a great opportunity for us in terms of scale, which helps us do more, and it's a great place where we have people working for us.*" [26]

Even though many software manufacturers still maintain majority of their R&D investment within the US, many are expanding to China. According to estimates Microsoft Corporation expects to spend a large portion of its multi-billion R&D budget in China. In 2006, Microsoft established an R&D group, which focuses

on curiosity-driven research and is the largest R&D investment outside of the US. This move highlights Microsoft's commitment and long-term investments in China. [27]

5 Challenges and Solutions for Innovation in China

There are many unique challenges facing Chinese manufacturers today. Let's look at some of the specific challenges facing our interviewed electronics manufacturing companies.

Perhaps the biggest challenge facing every Chinese manufacturer is the rising cost of labor and materials. Along with the county's rapid development, the cost of labor is increasing (and as a result, the cost of materials). The success in imitation has come as a result of the low labor costs, but what happens when China looses its competitive edge in this area? There must be a new competitive advantage in place and that is why radical innovation is so important.

Chinese manufacturers also have to deal with the rising cost of energy and shortages of natural resources and as environmental concerns receive more attention, companies have to face the expense of being more environmentally friendly. Additionally they are challenged by the exchange rate as their currency grows in value compared to the dollar, revenue from exports goes down.

There are also unique challenges to innovation in China. In our interviews, we saw that Company 2 recognized that the mindset of Chinese people tends to be towards collectivism and conformity which does not always encourage creativity and innovation. There are also concerns that the Chinese education system does not foster creativity.

Turning to the challenges facing the software industry, we have found that in spite of China's piracy policy implementation it still ranks among the top software pirates in the world. As China is moving towards being innovative, the piracy problems will hamper its own software development and intellectual property issues. There is a rising trend in the number of R&D firms in China. Will this trend continue to establish China as an innovator? It depends upon how well they implement their policies to curb piracy.

When we look at innovation and the workforce, we see that an efficient way to make significant progress is to make companies the driving force in technological innovation by cooperating academies under Chinese government's guideline and support, and subsequently make China an innovation oriented country. There is no doubt that China has talent in their universities and colleges, but most of the fresh graduates lack industrial or practical experience. To bridge this gap between industry and academies, one of the possible solution could be cooperation either by building common labs and fabs or to integrate industrial technology with university curriculum. [28] A vivid example would be Intel's Vietnam Study Abroad Program with Portland State University in Portland, Oregon. This program provides a student with an excellent education at Portland State University and an engineering career with Intel in Vietnam. Intel sponsor's engineering students from select universities in Vietnam, currently in their third year, to complete their Bachelor of Science degrees in engineering field at Portland State University. Intel Vietnam Scholars will begin the first of two years of academic study at PSU. Upon graduation, Intel Vietnam Scholars will return to Vietnam to begin engineering careers with Intel in Ho Chi Minh City. [29]

In this report, we have looked at three key areas that impact innovation in China. In the electronics manufacturing sector, innovation has become central to future success in an uncertain marketplace. The workforce is certainly full of potential, but careful management is required to fully take advantage of this potential. Great strides have been made in copyright protection, but this is an area

that needs continued attention so that innovative Chinese companies can continue to excel. While each area faces unique challenges, there is no doubt that innovation in China is on the rise.

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