Two Emerging Innovative Dragons: An Analysis of the IPR Strategy of China’s Huawei and ZTE

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Abstract—China has been experiencing a historical take-off in its use of intellectual property rights (IPR). This paper discusses the IPR strategy of two leading high-tech Chinese firms, Huawei and ZTE, analyzing how they are moving to global leadership in the telecom equipment market. Specifically, the paper addresses their IPR performance with respect to patenting and trademark registration in the most relevant global IPR systems. By 2008 Huawei had already reached world leadership in the international PCT patents applicants' ranking, while in 2011 Huawei was substituted by ZTE in that position (with Huawei dropping to 3rd place). The paper shows how both firms have developed dynamic capabilities in innovation by investing strongly in R&D. This investment has reflected in a dramatic growth of patent applications. Even if a direct correlation between patent applications and capacity to innovate is not assumed, the growing demand for patents (and more recently trademarks) in different IPR systems reveals an aggressive technological and commercial stance of both firms on the global market.

I. INTRODUCTION

The People’s Republic of China (hereafter China) has been experiencing a historical take-off in its use of intellectual property rights (IPR) [1]. Huawei Technologies and ZTE, two of the biggest and most successful and competent China’s high tech companies are standing out within this IPR surge. Both Huawei and ZTE are two of the most relevant examples of companies that got out of the relative technological backwardness that characterized the country until recently [2].

In science, technology and innovation (ST&I), China’s rise has been particularly impressive. Since 1999, Chinese investments in research and development (R&D) have grown on average 20% per year, reaching 1.44% of GDP in 2007, converging rapidly to an average of 2.1% of the group of major advanced countries [3], [4]. By 2009 China overtaken Japan to become the world’s second biggest spender on business R&D just behind the US. China’s R&D investment rose to 12.8 percent of the world total in that year, up from 2.2 percent in 1993\textsuperscript{1}.

China has shown a remarkable patenting performance both domestically and abroad. The number of invention patents granted by the USPTO reached 2657 in 2010 from just 90 in 1999. The number of Chinese international patent applications under the Patent Cooperation Treaty (PCT, in its English acronym), which ensures protection of domestic inventions in 142 countries, more than tripled between 2006 and 2010, with China moving up from eighth to fourth place in the PCT ranking, overtaking South Korea, France, the UK and the Netherlands and shortening the differential against Germany, which ranks third behind the US and Japan [4].

In 2008 China became the second largest producer of scientific knowledge, expressed in number of articles published after revision critical in scientific journals, behind only the United States. According to data released by the NSF, the Chinese scientific output grew at an annual rate of 18.7% between 1998 and 2007, jumping from 0.3% to 7.8% of the scientific world production in the period. Other sources indicate that from 2006 there was an acceleration in the publication of scientific papers by China, which, in quantitative terms, overtook Germany, Japan and the United Kingdom, trailing only the United States [5], [6], [4].

The survey conducted by Thomson Reuters scientific production over ten years in 10,500 scientific journals shows that the number of articles published by Chinese researchers nearly quadrupled, rising from just 20,000 in 1998 to more than 112,000 in 2008, reaching 12.6% of the world total [6].

China is no longer just a manufacturing country, exporting low-tech industrial products or handling the labour-intensive component of high-tech products. Following in the footsteps of other Asian countries in the catching-up process, China has moved quickly up the value chain. In the last decade, the country has increased its participation in global value-added in high-tech industrial sectors, reaching 14% of the world total in 2007, second to the United States only. With an average annual growth rate of around 28% in the period 2000-09, exports of high tech goods jumped from 18.5% in 2000 to 31% of total industrial exports in 2009 [7][4].

Hidden behind these macro figures, lies the performance of a number of Chinese companies who have grown from anonymity becoming world leaders in their field of technology. This is the case of ZTE (Zhongxing Telecom Equipment) Corporation and Huawei Technologies Co. By 2008 Huawei had already moved to be the world leader in the PCT patents applicants ranking. Last year (2011) ZTE moved to the 1\textsuperscript{st} place in this ranking, while Huawei dropped slightly to the 3\textsuperscript{rd} position.

In this paper, we discuss the IPR strategy of Huawei and ZTE, analyzing how they are moving to global leadership in
the telecom equipment market. The paper is divided into 7 sections. Section 2 deals with the link between Intellectual Property Rights (IPR) and innovation. Section 3 explores this link in China. Section 4 broadly presents the two companies which are the object of this research. The following sections, 5 and 6, are dedicated to empirical exploration, presenting respectively data on patent and trademark applications by ZTE and Huawei in different IPR systems, analyzing the technological and trademark specialization of both companies. Finally, section 7 provides some conclusions.

II. IPR DYNAMICS AND INNOVATION

Since Jacob Schmookler [8] first proposed the use of patents statistics associated with innovation measurement, patent statistics have been widely used, with the number of new patents being taken as an indicator of innovation. There are several advantages of using patent statistics: a patent is associated with the development of a new technology; patent databases give easy access to information and enable comparison between countries; and patent analysis also allows for the understanding of knowledge flows, through citations analysis [9].

Nevertheless, several authors have also highlighted problems in using patents as an innovation indicator ([12]; [13]; [14]). Since the pioneering study of [15] it is well known that the intensity of patent demand varies extensively across sectors. References [15] and [16] have further shown a strong variance in the use of patents vis-à-vis other appropriability mechanisms. It is also known that traditional SMEs display a much lower patenting propensity than larger firms [9]. Moreover, [17] point out how patent usage depends on national laws.

The link of patenting with innovation in competitive markets must be seen also with some caution, since many studies link the patent boom with a more intensive strategic use of patents by business firms. Reference [18] points out that patenting might be important for new firms as a means of signaling their innovative capacity while mature firms tend to use patents in a more defensive manner and build up large IPR portfolios.

Similar results have been highlighted for other advanced economies. [19] stressed that business firms use patents as a negotiation lever; [20] demonstrated that beyond using patents to avoid imitation, business firms also use them to protect domestic markets by keeping competitors out of their relevant markets and to improve their technological image (which may be important for our analysis of Chinese firms).

Most studies carried out in relation to IPR usage in emerging economies focus on patents but little attention has been paid to the use of trademarks [1] [21]. In this paper, both patents and trademarks are adopted to generate insights into the innovation potential of both companies in study.

The joint use of patent and trademark data has the additional advantage of providing a more reliable perspective on the innovation potential. We observed above on the diversity of purposes patents serve in modern economies in addition to their traditional role as a means for protecting innovation. In this context, several studies have identified the need for complementary indicators that, together with patents, may provide a more realistic and encompassing account of innovation capacity [1].

The so-called Oslo Manual [22] was written under the main assumption that patents do not reflect the different sources and shapes through which innovation occurs, especially in the services sector where organizational change and the co-creation of new solutions with clients often takes place beyond the scope of R&D labs.

This discontent with a view of innovation as necessarily technological and R&D based led to the suggestion of alternative approaches. Several empirical studies put forward alternatives such as the share of new products in total sales [23], measures of organizational change within firms [24], innovation counts [11], number of new products [25] and the use and citation of patent information [14]. Within this context, there has been increasing interest in the use of trademarks as an innovation indicator [1].

In what concerns new trademarks, the narrative is somewhat different. Applications for new trademarks are related to broader marketing strategies where firms apply for a trademark to strengthen product differentiation [21]. Typically, new trademarks involve a diversity of steps such as changes in branding, packaging and labeling, communication with the potential market through public relations activities and publicity and promotion [26], which, altogether, may involve important changes in firm behavior. What might be argued is that trademarks are more downstream, related to the launching of new products and helping them get established in the market, rather than to the inventive step itself as happens with patents, hence more connected with innovation per se.

[27] found that financial markets value the registration of trademarks and those trademarks are viewed as an effective tool to at least partially appropriate the value of marketing investments, which is true across many industries and is not limited to only a particular group of quality trademarks. In this regard trademarks are different from patents, which are shown to be ineffective for appropriation in some industries [28]. Furthermore, prior research has found that investors value primarily those patents that receive a lot of citations [18]. By filing an own trademark or an opposition against a rival’s trademark, firms show to the financial markets that they want to protect their investments. Stock markets seem to value such activity and this value seems to be higher for more established trademarks [27].
Furthermore, through the use of empirical data, other studies have highlighted that there is a correlation between trademark use and innovative activities [1]. These studies found a significantly positive relationship across different sectors between trademarks applications and several other innovation indicators, such as patents, R&D or new products launched [29]. This correlation would also seem to be stronger in service [30]; [21] and in high-tech sectors [21], especially in sectors such as the pharmaceutical industry [31] [29].

III. IPR DYNAMICS IN CHINA

Some studies have been produced on the rising IPR usage in China. Reference [1] in their study about China and India, using IPR data, emphasize that China is rapidly catching up with the more developed nations and that this surge in IPR may relate with China’s innovative capacity.

In relation to China, and referring to a sample of medium and large-sized firms, [32] have shown that the increase in patenting is linked not only to rising R&D expenditure but also to foreign direct investment inflows and to a changing legal framework that favors patent owners. [33] in their study comparing the Chinese innovation system with 21 other countries, argue that China will "catch-up" in terms of indicators of S&T and economic performance. They demonstrate that the Chinese technology productivity is positive (the investment in R&D results in increased patenting in an even greater proportion). Similarly to [32], [33] sustain that China's patent explosion has not a single cause. Opening up, economic reform, and a reasonably stronger legal system have shaped a more open setting for patenting and have increased the return to patenting. [34] adds to this discussion claiming that the patenting increase in China is also strongly correlated with the launch of patent subsidies programs (and this practice, has not, accordingly with the author diminished the quality of patents).

One issue raised in relation to the patents issued by China is their quality. Using patent citation ratios is an important measure to accessing patent quality [35]. The citation ratio is defined as the average number of a country's patents cited in subsequent patents. The underlying assumption in using patent citations to measure patent quality is that frequently cited patents probably involve significant technological advances [36]. [36] points out that patent quality is extremely heterogeneous in China, with most patents being of a lower quality, as indicated by an average citation ratio of 3.6 which is the same for both countries. [37] also echo this preoccupation with possible patent quality problems in China.

Taking in consideration this limitation, [38] focused their analysis exclusively on USPTO data. These authors show that China has increased dramatically patent demand in the US, although they point out that this trend should be analyzed carefully because many of the applications at the USPTO stem from joint inventions between China and other countries. [38] show that China was functioning at productivity levels below their foreign counterparts but made startling progress in its technological capabilities. These increase in technological capability seems to be not only a by-product of economic pressures associated with growth but also because of the adoption of innovation-based technology development policy, the recruiting of a higher quality workforce, and most importantly, the rapid restructuring of its economic system into a modern and competitive market economy [38].

Reference [39] indicates that there seems to be some signs of transition from industrial-based to knowledge-driven activities and the formation of evolving propagating behavior in the production of indigenous technology.

The success of the Chinese strategy of catching-up is indisputable and is expressed in several indicators. In the biannual report World Economic Outlook April 2011, the International Monetary Fund (IMF) estimates that, in purchasing power parity, China's GDP will supplant the U.S. GDP in 2016, raising its stake to 18.0% in global GDP (13.6% in 2010) [4].

China's emergence as a major player in science and technology has also raised several predictions about the future path of their investments in R&D activities and results of scientific research and technology [4].

In terms of published scientific articles, according to the Royal Society [40], China, which has overtaken the UK as the second-leading country in the scientific world, will probably overtake the United States before 2020. Estimates made from a simple linear extrapolation of the data published by Elsevier suggest that the Chinese leadership could occur as early as 2013. Since the calculations based on data from Thomson Reuters Web of Science indicate that the Chinese overtaking will occur in 2015 ([41]; [4]). Reference [42] suggest that China will overtake the U.S. as a scientific superpower around 2018. The Royal Society [40], extrapolating recent trends of the annual records of foreign patents in the USPTO estimates that China will overtake South Korea in 2018 and Japan in 2028. With only 90 patents granted by the USPTO in 1999, China jumped to 1,655 in 2009, thus getting up to the 9th position in the ranking of the foreign countries with the largest number of patents filed in the U.S., far behind Japan, which with 35,501 was on the top of that ranking. Reference [1] predicted a relative fast "catching up" with the USA, in terms of patent applications, pointing out as possible dates 2015/2016 for PCT applications, 2030 for EPO applications and 2040 for USPTO applications.

IV. ZTE E HUAWEI

In 2010 for first time two Chinese companies - ZTE (Zhongxing Telecom Equipment) Corporation and Huawei Technologies Co. - were among the top ten in the rankings which WIPO publishes every year with the leading
companies filing for patents under the international PCT patent system.

A. Huawei
The telecommunications company Huawei Technologies embodies China's emergence on the world stage of high-tech and innovation. Founded in 1988, in the Chinese province of Guangdong, the company, Huawei emerged as a spin-off of the PLA research sector, combining foreign technology with the labor cost advantages of labor. Huawei grew by establishing joint ventures with multinationals and entering international markets, to become the second largest manufacturer of infrastructure equipment for mobile telephony in the world and the fifth largest manufacturer of telecommunications equipment and devices in general, behind Cisco, Ericsson, Nokia Siemens and Alcatel-Lucent [43].

[2] identify the following 3 stages of international development of Huawei:

1) Tentative Stage (1996-1999)
This was the companies’ first contract with an overseas partner (Hong Kong’s Hutchison-Whampoa). The competitive advantages explored here were not only low cost but supply flexibility. In 1997, a joint venture was established with Umberto Konzern Russia, entering the Russian market, and a joint venture was set up in Brazil. In 1998, Huawei entered Yemen and Laos, and started business in Kenya. The company won market share with the reputation being of a high-quality mobile-network builder though offering lower costs than the competition [2].

2) Take-off Stage (1999-2001)
In 1999, Huawei launched the “New Silk Road” marketing initiative and participated in several international exhibitions while inviting foreign customers to China to visit Huawei’s campus in Shenzhen [44]. In the same year Huawei entered Thailand, Singapore, Saudi Arabia, South Africa, and Egypt. By 2001, it had established branch offices in over 40 countries and its international sales reached 12% of total sales². According to [2], by this time Huawei differentiated itself from its rivals on 3 mains aspects: Price - it was 5 to 10 percent lower than the prices practiced by rivals such as Ericsson and Nokia (cheaper yet not so cheap that could lead to low quality perception); Relationship building - in Africa Huawei established local training centers in countries as Nigeria, Egypt, Tunisia, Angola and Guinea, which altogether trained more than 2000 people (creating local employment and thus assuring that future local governments would use Huawei equipment and maintenance services); The third was the introduction of ecological and power saving equipment, which operated with solar and wind energy. It was welcomed not only by providers in Africa, but later by European providers.

3) Mature Stage (2001-2012)
Huawei entered the EU market in Germany offering a Synchronous Digital Hierarchy (SDH) system in 2001 and formed joint venture with Nokia Siemens Networks for TD-SCDMA. In 2004 established its European headquarters in London while British Telecom designated Huawei as provider of Multi-Service Access Node (MSAN) and optical transmission. In 2006 Vodafone selected Huawei to build the radio access part of its UMTS/HSDPA (High-Speed Downlink Packet Access). Cooperation in R&D was also a notable characteristic in this period; since Huawei established 10 R&D centers with Texas Instruments, Motorola, IBM, Sun Microsystems, Microsoft, etc. [2].

Summing up, in the last decade, Huawei went international, expanding in various parts of the world. In the process of internationalization, the company has established R&D centers in Dallas, Bangalore, Moscow and Stockholm. In addition to benefit from foreign technology through R&D centers abroad, Huawei has many R&D centers in China itself, in cities like Beijing, Shanghai, Nanjing, Hangzhou, Xi’an and Chengdu. All these centers operate by developing its own technology in close collaboration with government research institutes such as the Chinese Academy of Telecommunications Research, Research Institute of Telecommunications Transmission, Institute of Electronic Engineering Xi’an and Beijing Design Institute. In addition to partnerships with multinational companies and research institutes, another source of the success of Huawei lies in the fact that more than half of its 60,000 employees participate in R&D activities, an area where the company spends about 10% of its annual revenues [45].

B. ZTE
Founded in 1985, ZTE, has reached the status of China's second largest telecommunications company. ZTE also owns 14 R&D centers around the world, of which eight are located in China. They work closely with dozens of government research institutions in various partnership projects in R&D [46]. In 2011 the company had revenues of 13680 Million dollars and listed 89,786 employees.

V. METHODOLOGY AND DATA

As [1] mention, when conducting international comparisons on patent data the analysis should take in consideration that data on patents filed or granted by national patent offices might be biased towards domestic users. [47] stated this problem with regard to US domestic users of USPTO (United States Patent and Trademark Office) patents. This situation stems from the fact that domestic firms typically tend to protect with a higher intensity in their home markets. Many studies have however used USPTO patents under the assumption that whenever an invention has

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² In: //www.huawei.com/corporate_information/milestones.do (June 2012)
significant market potential it will seek protection in the US regardless of its geographical origin, as the US is considered the most dynamic technological market in the world. The recommendation in that case is that one should control for possible "domestic bias", not directly comparing patents filed or granted to US residents with those of foreign origin. An important alternative to using US data alone is to look at the so-called triadic patents, which are families of patents with share a priority data and are successively filed at the USPTO, the JPO (Japanese Patent Office) and the EPO (European Patent Office). The main disadvantage of the triadic patents statistics is that they are only available with a certain time lag. This is one reason why many studies opt to carry out international analyses using both the so-called “international (or PCT) patents” and European (or EPO) patents. The PCT system has matured since the 1970s when it was established, as its geographic span has widened from 43 countries initially to 142 contracting states in September 2009. The fact that a single filing under the PCT agreement provides potential coverage in many different countries has made this a truly global system, with an annual growth rate of above 16% over the last two decades. Many studies have also used the European patents granted by the EPO. Further to using PCT or EPO patents, there is the option to simultaneously draw on data from several national PTOs.

The same comments put forward for the national and international patent systems also apply to the analysis of trademarks, as the “home-bias” might similarly occur. However, no statistics have been produced on “triadic trademarks”. In this case, the best option would be using the PCT equivalent, which are the “international trademarks” registered under the WIPO in the context of the Madrid Agreement [1]. Additionally, there is the possibility of analyzing the EU’s Community Trademarks, which are managed by OIMH, a European organization. The "WIPO-Madrid system for the international registration of trademarks provides one single procedure for the registration of a trademark in several territories. It is governed by two treaties, the Madrid Agreement and the Madrid Protocol, and is administered by the International Bureau of WIPO in Geneva, Switzerland" [48]. The Madrid Union system (that comprises both the Agreement, that has been in force for 110 years and the Protocol that has been in force since 2004) has 85 members. As for the Community trademark system, it was established in 1997 having the 27 EU countries as its members.

To collect the required information (patents and trademarks) several databases were used in this research. In PCT applications we used PATENTSCOPE searching all international applications of the two companies until 2011; we also used Spacenet searching all National Patent Offices (EPO, USPTO, KR, JPO) for patents from 201 to 2011.

For “international” trademarks (Madrid System) we used ROMARIN to search all international trademarks registered in the system by these two companies. We also searched for all trademarks applied for and registered in the four countries. In this case it was necessary to check the databases provided by each country. There is no uniform system such as Spacenet so we used: CTM, in U.S. Tess, in Japan the IPDL and in Korea KIPRIS.

We also analyzed the pendency times and the grant rates of both companies. For the [49], “grant rate” is the “number of applications that were granted during the reporting period, divided by the number of disposals in the reporting period (applications granted plus those abandoned or refused”). For the USPTO, “it is an allowance rate, which is based on applications allowed to be granted divided by the number of disposals. This rate includes plant patents and reissue patents in addition to utility patents”. Total pendency time, as traditionally measured, includes the average number of months from the patent application filing date to the date the application has reached final disposition (e.g., issued as a patent or abandoned), which is called a “disposal.” This pendency includes the time periods awaiting action by the PTO, as well as any time awaiting reply from an applicant [50].

To analyze grant rates and pendency times for Huawei and ZTE we selected a sample of 500 patents. Patents that were published recently were excluded (the probability of being already granted or disposed was lower) and we also excluded patents published a long time ago. The choice fell in patent filings published in the PCT, EPO and USPTO systems between 2006 and 2009. The sample was randomly selected as follows: 350 PCT applications, 75 in the USPTO and 75 in the EPO. The sample’s distribution with respect to publications by number of years was correlated with the amount of PCT publications year-by-year.

VI. PATENT AND TRADEMARK ANALYSIS

A. Patent demand

Analyzing PCT data on applicants we observe that Huawei and ZTE already account both for two percent of the total number of PCT applications over the last 3 years. In 2011, ZTE was even the top applicant in this system, in a ranking dominated by Japanese (Panasonic, Sharp, Toyota, Haier).

4 In relation to patents obtained by Spacenet for Japanese office was decided subsequently to abandon the collection of data due to problems of inconsistency and unreliability.
5 http://www.wipo.int/romarin
6 CTM http://oami.europa.eu/CTMOnline;
   JP http://eng.kipris.or.kr/eng/main/main_eng.jsp
7 In http://www.trilateral.net/index.html (June 2012)
and Mitsubishi) and German Companies (Bosch, Siemens, BASF).

If we take into account the total demand of PCT patents of Chinese companies, we observe that Huawei and ZTE have an overwhelming advantage over other Chinese competitors with the two representing about 30% of PCTs filled by Chinese residents. These trends seem less evident in other PTOs. In the USPTO Chinese residents don’t show on the top places and in the EPO ranks 16th position of the ranking. Notably, In the EPO 12 of the 20 top applicants are not European firms.

The table 1 affords a breakdown of the relative importance of non-residents in several PTO’s and specifically the share of both ZTE and Huawei.
The table indicates that both companies have a preference for the PCT over the foreign national systems. Nevertheless, the growth trend of both companies in the USPTO and EPO is dramatically high. In recent years, the two companies represent over 25% of PCT applications from Chinese residents (we should emphasize that this comparison is not straightforward since in this table we have both patent applications and patents granted). In 2011, Huawei and ZTE have had a slowdown of patents granted in the SIPO, but they were still progressing in foreign PTO’s grants.

B. Huawei Technologies and ZTE Corporation Technological Specialization

1) Huawei Technologies

Huawei – PCT patent applications by technological class

The main technological classes are H04W (Wireless Communication Network) and H04L (Transmission of digital information). There is a decrease from 2009 to 2010 primarily due to reduced patent publication H04L. This effect is mitigated by the almost doubling of patent applications in class H04W (Figure 4 in Appendix).

Huawei – EPO patent applications by technological class

Similarly to the state of PCT patent applications (Figure 5 – Appendix), the most predominant classes are IPC H04L (Transmission of Digital Information) and H04W (Wireless Communication Networks). The peak is reached in 2009 and has since declined. The H04L is the class that has fallen more since then. Comparing with the PCT system, the EPO patent applications decreased in 2011 and their absolute number of publications is much lower (30/40%).

Huawei – USPTO patent applications by technological class

In the USPTO (Figure 6), the trend is similar to the one seen on EPO patent applications. The peak number of patent applications was reached in 2009 and since then we observe a decrease. Regarding the IPC classes there are no substantial differences. The second class with the most patent applications is G06F (Electrical Digital Data Processing) with the first and third class being respectively H04L and H04W. The black line refers to the number of patents granted in the year under review. These numbers are interesting, since it seems possible to observe a "time lag" between publications and grants. In 2011 there are nearly the same number of applications and grants. It is expected that the number of grants begins to decrease due to the decrease of patent applications in the last years.

Finally, regarding the KIPO we observe that the trends are more or less the same, although the absolute number is somewhat lower.

2) ZTE

PCT patent applications by technological class

There is a clear "explosion" of PCTs patent applications by ZTE in the last two years (2010, 2011) (Figure 7 in Appendix). The technological classes that are prevalent are H04W (Wireless Communication Network) and H04L (Transmission of digital information), so both companies seem to publish patents in the IPC same areas. There is great expertise in certain classes (H04W, H04B and H04L) that represent almost 80% of all patents issued.

EPO patent applications by technological class

For the EPO patent applications (Figure 8 in Appendix), we observe the same exponential growth since 2009, although the absolute number is only 10% of the PCT patent applications.

ZTE – USPTO patent applications by technological class

Regarding the USPTO patent applications (Figure 9), we observe a strong growth from 2009 onwards. The predominant technological Classes are H04W and H04L. The absolute numbers are below the EPO applications. It is somewhat expected that the number of concessions to rise markedly in 2013 due to the lag time between publications and grants.

C. Trademark Demand

We start our analysis on Trademarks by observing the top applicants of the Madrid System (62). Looking the table we realize that there isn’t a correlation between the companies that patent the most in the PCT system and the ones that file for more Trademarks. The only company that appeared in the top PCT applicants ranking and on this ranking is Philips. Following some of the conclusions in [1], there are two Chinese companies in this ranking.

TABLE 2 - TOP 20 MADRID APPLICANTS – 2010

<table>
<thead>
<tr>
<th>Rank</th>
<th>Applicant's Name</th>
<th>Country of Origin</th>
<th>2009</th>
<th>2010</th>
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<tr>
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<td>PAUL MURRIS PRODUCTS S.A.</td>
<td>Switzerland</td>
<td>37</td>
<td>187</td>
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<tr>
<td>2</td>
<td>MINEKAR AG</td>
<td>Switzerland</td>
<td>941</td>
<td>118</td>
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<tr>
<td>3</td>
<td>JDH GROUP LTD</td>
<td>Germany</td>
<td>58</td>
<td>112</td>
</tr>
<tr>
<td>4</td>
<td>SHANDONG CHANGANG INDUSTRY &amp; TRADE CO., LTD.</td>
<td>China</td>
<td>-</td>
<td>55</td>
</tr>
<tr>
<td>5</td>
<td>KONINKLIJKE PHILIPS ELECTRONICS N.V.</td>
<td>Netherlands</td>
<td>75</td>
<td>80</td>
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</tbody>
</table>


8 PATENTSCOPE only allows the display of the first IPC code of each patent. On the other hand, Espacenet allows the identification of more than one IPC code. Therefore, for data stemming from the national offices we established a ratio, where each code of a patent is worth the number of IPC codes that patent divided by one (Ex: X = Patent H04W, G06F and H04L; Valley H04W 0.33).

9 These values were omitted for formal reasons but are available upon request to the authors.
D. Trademark specialization by NICE classes

1) Huawei

There are only 16 trademarks registered by Huawei through the Madrid System, which are listed on Table 3 in the Appendix. We can observe that the predominant NICE class is 9 (computer hardware and software or electrical and electronic other apparatus of a scientific nature) and that most trademarks were applied for over 10 years ago. Most trademarks were also assigned to more than one country.

Huawei – evolution of OHIM Trademark applications:
The number of OHIM trademarks applications has registered a very high growth in the past few years (Figure 10, Appendix). Huawei has registered 150 of its applications [51], and has 31 applications under examination. Regarding the distribution through NICE classes (taking into account several trademark types) the distribution is concentrated around class 9 (Electrical apparatus and scientific).

Huawei – evolution of USPTO Trademark applications:
As in the OHIM trademarks, also the USPTO applications by Huawei (Figure 11 in Appendix), have registered a very high growth in the past few years. In 2011 Huawei applied for 170 trademarks, up from 10 in the previous year. Also, once again, the main Nice class was 9 (Electrical apparatus and scientific) with 91% of the applications (USPTO, 2012).

2) ZTE Corporation

ZTE Trademarks in the Madrid System

There are only 16 trademarks registered by ZTE through the Madrid System, which are listed on Table 6 in the Appendix. We can observe that the predominant NICE class is 9 (computer hardware and software or electrical and electronic other apparatus of a scientific nature) and that most trademarks were applied for very recently. Most trademarks were also assigned to more than one country but in fewer countries than Huawei.

ZTE – evolution of OHIM Trademark applications:
ZTE has only 29 trademarks registered in OHIM, and most were applied for in the past two years (considerably fewer than Huawei). As for specialization, ZTE has 35% of trademarks registered in class 9 but also 31% in class 8 “Telecommunications” (Figure 12).

ZTE – evolution of USPTO Trademark applications:
Regarding Trademarks in the USPTO, as in the previous analysis, again the growth is very step in past few years. Also, most of the trademarks are concentrated in Nice 9 class followed by 8" (Figure 12 in Appendix).

E. Pendency times and Grant Rates

1) Huawei Technologies

In the following table, using the number of applications per year in each office and the number of grants in relation to the year of publication we calculated an approximation (Grant Rate definitions may vary from country to country) of the Grant Rate for our previously mentioned sample.

<table>
<thead>
<tr>
<th>Grant Rate</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>Average (05-08)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP</td>
<td>66.67%</td>
<td>44.59%</td>
<td>34.07%</td>
<td>18.46%</td>
<td>6.25%</td>
<td>X</td>
<td>X</td>
<td>33.50%</td>
</tr>
<tr>
<td>US</td>
<td>66.67%</td>
<td>51.11%</td>
<td>52.00%</td>
<td>33.75%</td>
<td>21.31%</td>
<td>4.35%</td>
<td>100.00%</td>
<td>32.47%</td>
</tr>
<tr>
<td>JP</td>
<td>75.00%</td>
<td>57.14%</td>
<td>30.00%</td>
<td>0.00%</td>
<td>25.00%</td>
<td>X</td>
<td>X</td>
<td>42.42%</td>
</tr>
<tr>
<td>KR</td>
<td>X</td>
<td>100.00%</td>
<td>57.14%</td>
<td>44.29%</td>
<td>0.00%</td>
<td>X</td>
<td>X</td>
<td>40.00%</td>
</tr>
</tbody>
</table>

Source: Own calculations

Analyzing the grant rate we verify that the USPTO has a higher rate and that Huawei average values seem rather high. EPO grant rates steadily declined in the recent past. The average pendency time in all offices analyzed for Huawei was 3, 67 years.

2) ZTE

For our sample, ZTE Grant rate in the selected PTO’s is much lower than Huawei. The values are exceptionally low in the EPO. In the case of ZTE the average pendency times within our sample were of 4,63 years and in the USPTO this value reached an average 4,84 years.

<table>
<thead>
<tr>
<th>Grant Rate</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>Average (05-08)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP</td>
<td>0.00%</td>
<td>10.81%</td>
<td>3.85%</td>
<td>2.67%</td>
<td>1.90%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>3.41%</td>
</tr>
<tr>
<td>US</td>
<td>88.89%</td>
<td>46.15%</td>
<td>40.00%</td>
<td>16.28%</td>
<td>16.44%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>16.46%</td>
</tr>
<tr>
<td>JP</td>
<td>100.00%</td>
<td>0.00%</td>
<td>33.33%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>3.64%</td>
</tr>
<tr>
<td>KR</td>
<td>100.00%</td>
<td>100.00%</td>
<td>100.00%</td>
<td>37.50%</td>
<td>11.11%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>35.32%</td>
</tr>
</tbody>
</table>

Source: Own calculations

F. Compared Patent activity with competitors

In this sub-section the objective is to analyze the stock of patents for some international Huawei and ZTE competitors (Figure 13 in the Appendix– lines are patent applications and bars patent grants).

The number of patent applications for all companies except Ericsson seems to be declining, contradicting the tendency we’ve shown for Huawei and ZTE, until at least the last couple of years.

By 2010 there was a general increase in patent grants. Alcatel was the one with the fastest rise. Both Cisco and Alcatel had in 2009, 2010, 2011 more grants than applications (this originated in large number of publications before 2007). Patent Grants for the selected competitors are much higher than ZTE and Huawei (at least in the USPTO) and only in 2011 Huawei manages to catch up with its competitors in the USPTO.

In specific technological fields, and using PCT data, [2].show that in packet switching systems Huawei is the
leader in PCT applications (also in “Systems Providing Services or Facilities to Subscribers”). And in patent applications regarding WIMAX and “Next Generation Network” technology ZTE is the leader, closely followed by Huawei.

VII. FINAL REMARKS

Huawei and ZTE emerged, in a few years, as major players on the global scene of telecommunications equipment. Huawei is 2nd in the market for telecoms network equipment and ZTE is 4th in the production of mobile phones, although Huawei is bigger and has more international experience.

Patent applications for ZTE and Huawei have risen dramatically in the past ten years. Huawei has meanwhile reached a plateau in its patent applications but ZTE is still growing fast. Over the last 3 years both companies were top PCT applicants, with Huawei being first in 2009 and ZTE in 2011. We have found that both companies have uses the PCT system as doorway into other countries. Further it has also become clear from the analysis that the overwhelming majority of these PCT applications have a priority date referring to the Chinese SIPO. Huawei and ZTE seem to be implementing an offensive patent strategy. An offensive patent strategy intends to build barriers to block competitors from gaining entry to once own proprietary technologies. Using an offensive patent strategy means filing patents as soon as is practicably possible. Filing a large number of patent applications and later maintaining the issued patents is expensive; on the other hand, an offensive patent strategy may derive large licensing incomes. Given the expenditure, an offensive patent strategy is often available only to large organizations, since small companies generally cannot afford the costs of filing and maintaining patents. Both ZTE and Huawei managed to attain a critical size that allowed them to initiate a more bold IPR strategy. Beyond size, an offensive patent strategy is more important for companies operating in very competitive fields.

The innovation capability and self-developed technologies have been the key to ZTE and Huawei in catching-up with the competitors. These companies mostly depend on in-house R&D development, supplemented in the past, with external alliance to build their innovation capability. Both firms used their capabilities and at same time that they approached the market in the low end they have built they own core competencies for innovation. In terms of specialization both companies are concentrated two specific technological classes: H04L - Transmission of Digital Information; and H04W - Wireless Communication Networks.

Although in the EPO Huawei seems to be already a major player (showing up in the 20 top patent applicants), in the USPTO both companies are absent from the top 50 (which is organized in terms of patent grants). Nevertheless, this seems in accordance with both firm strategies. Huawei firstly became an international company in Asia, then Africa and then Europe (lastly USA), starting its IPR surge some years before ZTE. It is possible to admit that even in the USPTO, Huawei and certainly ZTE will be soon among the top companies in terms of patent grants, as their applications in the most recent years are still under examination.

Regarding, pendency and grant rate, our research seems to indicate that ZTE patents may have a lower quality. Both companies seem to be less active in terms of Trademarking. Nevertheless the number of trademark applications has greatly increased in 2010/2011. Both companies seem to concentrate their trademark applications in Class 9 (computers and software and hardware, other electrical or electronic apparatus of a scientific nature).

To sum up: both Huawei and ZTE have developed dynamic capabilities in innovation, first through learning by absorbing advanced technologies, and more recently by investing strongly in R&D. This investment has reflected in a dramatic growth of patent applications. Even if we don’t assume a direct correlation between patent applications and capacity to innovate, the growing demand for patents (of more recently trademarks) in different IPR systems reveals an aggressive technological and commercial stance on the global market.

REFERENCES


APPENDIX

Figure 4 - Huawei – PCT patent applications by technological class
Source: [52].

Figure 5 - Huawei – EPO patent applications by technological class
Source: [49].

Figure 6 - Huawei – USPTO patent applications by technological class
Source: [50].
Figure 7 - ZTE – PCT patent applications by technological class
Source: [52].

Figure 8 - ZTE – EPO patent applications by technological class
Source: [49].

Figure 9 - ZTE – USPTO patent applications by technological class
Source: [50].
TABLE 5 - HUAWEI TRADEMARKS IN THE MADRID SYSTEM

<table>
<thead>
<tr>
<th>Title</th>
<th>Basic application</th>
<th>Date of registration</th>
<th>Nice Class</th>
<th>Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>7858031 - ViewPoint</td>
<td>CN. 07.08.1997</td>
<td>17.05.2007</td>
<td>8</td>
<td>31</td>
</tr>
<tr>
<td>743797 - HUAWEI</td>
<td>CN. 14.04.1997</td>
<td>07.07.2009</td>
<td>8</td>
<td>2</td>
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<tr>
<td>719058 *</td>
<td>CN. 14.04.1997</td>
<td>08.07.2008</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>717582 - HUAWEI</td>
<td>CN. 14.04.1997</td>
<td>08.07.1998</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>7437712 - CRC OS</td>
<td>CN. 14.11.1998</td>
<td>04.12.2009</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>748646 - Qihuiwey</td>
<td>CN. 21.05.1998</td>
<td>04.12.2006</td>
<td>8</td>
<td>35</td>
</tr>
<tr>
<td>749347 - OppX</td>
<td>CN. 21.05.1998</td>
<td>04.12.2006</td>
<td>8</td>
<td>31</td>
</tr>
<tr>
<td>745448 - NONIT</td>
<td>CN. 20.05.2000</td>
<td>04.12.2006</td>
<td>8</td>
<td>17</td>
</tr>
<tr>
<td>805278 - HUAWEI OptX</td>
<td>CN. 14.11.2001</td>
<td>04.08.2003</td>
<td>8</td>
<td>28</td>
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<tr>
<td>107887B - SmaKit</td>
<td>CN. 02.12.2001</td>
<td>07.04.2011</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>1068418 - HUAWEI SmartCar</td>
<td>CN. 22.10.2010</td>
<td>11.09.2011</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>1109955 - MediaPad</td>
<td>CN. 09.06.2011</td>
<td>24.11.2011</td>
<td>8</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: [52].

Figure 10 - Huawei – evolution of OHIM Trademark applications
Source: OHIM (2012)

Figure 11 - Huawei – evolution of USPTO Trademark applications
Source: [50].

TABLE 6 - ZTE TRADEMARKS IN THE MADRID SYSTEM

<table>
<thead>
<tr>
<th>Title</th>
<th>Basic application</th>
<th>Date of registration</th>
<th>Nice Class</th>
<th>Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1093712 - ZTE</td>
<td>CN. 26.01.1998</td>
<td>13.05.2011</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>1095779 - ZTE</td>
<td>CN. 26.03.1999</td>
<td>17.05.2011</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>761884 - ZTE</td>
<td>CN. 21.10.1999</td>
<td>02.07.2001</td>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>762951 - ZTE</td>
<td>CN. 07.11.2000</td>
<td>07.08.2001</td>
<td>9</td>
<td>30</td>
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<tr>
<td>849586 - EMBSYS</td>
<td>CN. 12.11.2004</td>
<td>08.03.2005</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>856832 - UniWide</td>
<td>CN. 16.11.2004</td>
<td>12.05.2005</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>849571 - iBOSS</td>
<td>CN. 12.11.2005</td>
<td>08.03.2005</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>884207 - NetNumen</td>
<td>CN. 02.08.2005</td>
<td>13.08.2006</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>929599 - NGCC</td>
<td>CN. 23.08.2005</td>
<td>30.05.2007</td>
<td>9</td>
<td>9</td>
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<tr>
<td>929471 - ZTE</td>
<td>CN. 05.09.2005</td>
<td>14.03.2007</td>
<td>35, 38, 42</td>
<td>5</td>
</tr>
<tr>
<td>929472 - ZTE</td>
<td>CN. 05.09.2005</td>
<td>14.03.2007</td>
<td>35, 38, 42</td>
<td>5</td>
</tr>
<tr>
<td>1006929 - GoTa</td>
<td>CN. 21.02.2008</td>
<td>19.05.2009</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>1066777 - eye will</td>
<td>CN. 07.10.2009</td>
<td>21.01.2011</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

Source: [51].
Figure 12 - ZTE – evolution of OHIM Trademark applications
Source: OHIM (2012)

Figure 13 - ZTE – evolution of USPTO Trademark applications
Source: [50].

Figure 13 – Patent applications publications and Grants, selected competitors - 2007 – 2011
Source: [50].