

Introduction

The current state of innovation in China

Since 1949 the Communist government has implemented a series of five-year plans that have guided the development of China from a poor developing nation to the second-largest global economy behind the United States in terms of both purchasing power and, more recently, gross domestic product (GDP). China has just completed the 11th Five-Year Plan for National Economic and Social Development. This plan highlighted innovation as a focus, and the corresponding science and technology plan articulated the country's goal to become an innovation-oriented society by 2020. Many of the developments of the past five years illustrate how far China has moved towards that goal.

The recently released 12th Five-Year Plan sets a number of challenging goals aimed at continuing the transition from 'Made in China' to 'Designed in China'. In order to achieve this, the government plans to invest heavily in science and technology education and research and development (R&D) and develop further China's IP rights system.

This chapter examines the ways in which China is further transforming from a manufacturing to an innovation economy and the prospect of achieving the targets set for the next five years. The driving factors for China's patent boom are analysed using data drawn from Thomson Reuters. Patent volumes and trends are explored, as well as the underlying causes of increased innovation, including economic and government policy factors and the changing IP climate in China.

Innovation trends

In 2010 the patent offices of Japan, the United States, Europe, Korea and China accounted for 77% of all new invention patent applications published worldwide, with Japan, Korea and China accounting for 54.8% of these. An analysis of patent volumes over the past five years from these five major offices shows that inventions from China have been growing faster than any other region.

Several attributes can be measured to identify and track innovation trends for a particular region:

- published patent application total volumes;
- local priority patent application volumes; and
- international patent application volumes.

Using data from the Thomson Reuters value-added patent collection Derwent World Patents Index (DWPI), the trends in patenting according to the numbers of published patent applications can be compared for the five jurisdictions.

Looking at the total volumes of published patent applications from the five patent offices from 2006 to 2010 (Figure 1), Japan has the highest volumes year-to-year during the period, but its lead narrows as the United States catches up. Europe and Korea have similar volumes and growth trends. The striking difference among these regions is in China – it is experiencing the most rapid growth and is poised to lead the pack in the very near future.

The projected growth in published patent applications for these regions shows that China is set to dominate the patent information landscape in 2011 (Figure 2).

In regard to the number of patent applications with local priority, China is again the exception, with dramatic growth in domestic applications from less than 90,000 in 2006 to nearly 230,000 in 2010 (Figure 3).

The ratio of domestic patent applications (those with local priority) to total patent volume for each region from 2006 to 2010 ranges from 13.7% at the lowest (in Europe in 2008) to 86.6% at the highest (in Japan in 2006) (Figure 4).

Japan shows a high proportion of domestic to total patent applications at a relatively steady level. The ratio for the United States declined over the period: domestic applications remained flat, while applications for patents made by foreign concerns have increased over time. Europe and Korea both display fluctuating ratios for the period, and the low ratios for Europe reflect the high proportion of applications with priority filings at patent offices other than the European Patent Office.

By contrast, China is the only country in the group where the ratio of domestic to total applications has grown steadily, from less than 52% in 2006 to nearly 73% in 2010. Clearly, applications by domestic concerns are growing more rapidly than those by foreign entities and are fuelling the Chinese patent boom.

Innovation is home grown

By 2010 the number of home-grown patent applications outstripped foreign applications by nearly three to one (Figure 5).

In an analysis conducted on Chinese domestic patent application volumes for 2006 to 2010 in selected technology fields, all sectors showed growth, with electrical machinery, digital communication, computer technology, measurement instruments and pharmaceuticals taking the top five slots in 2010 (Figure 6).

In a further analysis which looked at the global share of Chinese domestic applications (ratio of Chinese domestic applications compared to global applications) by technology for 2006 to 2010, the dominant industries by global share in 2010 were pharmaceuticals, food chemistry and basic materials chemistry, closely followed by biotechnology and digital communication (Figure 7).

A summary of the significant findings of these analyses is given here by technology area.

Electrical engineering

Dramatic growth rates over the period were observed for:

- electrical machinery, apparatus, energy (rising from 5,671 applications to 19,511 applications at a compound annual growth rate (CAGR) of 36.2%);
- digital communication (from 5,481 to 16,168 – a CAGR of 31.1%); and
- computer technology (5,872 to 16,066 – a CAGR of 28.6%).

Domestic patent applications for digital communication grew 20% faster over the period than global applications in this technology, and the global share of domestic Chinese patent applications for digital communication jumped from 14.4% to 29.8% over the period. In addition, annually computer technology domestic applications grew 25.9% faster than global applications.

Instruments

Growth rates for the technology fields of measurement and control grew at a CAGR of 35.6% (from 5,071

Figure 1

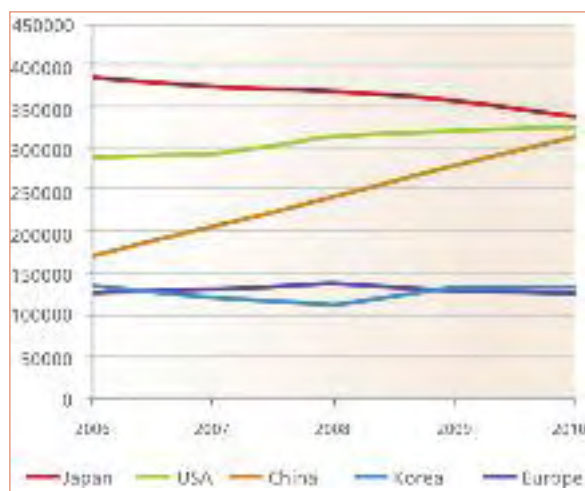


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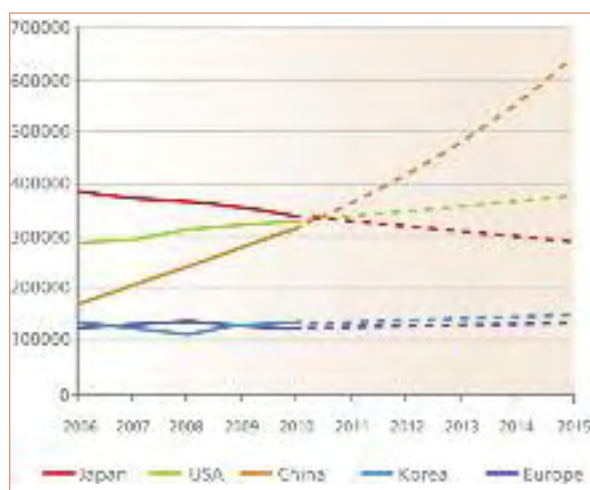


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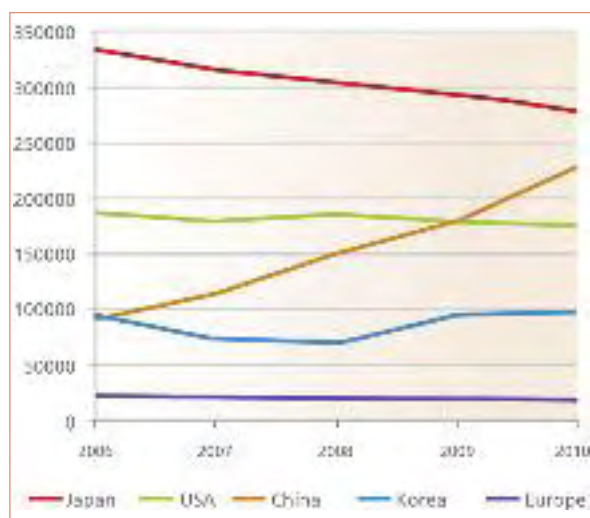


Figure 4

Ratio of domestic to total applications	2006	2007	2008	2009	2010	Average
Japan	86.6%	84.4%	81.9%	81.9%	82.1%	83.4%
US	64.4%	60.7%	58.9%	55.6%	53.6%	58.6%
Europe	16.5%	14.2%	13.7%	15.4%	15.1%	15.0%
Korea	69.0%	61.1%	61.7%	72.0%	72.8%	67.3%
China	51.9%	55.2%	62.2%	64.1%	72.7%	61.2%

Figure 5

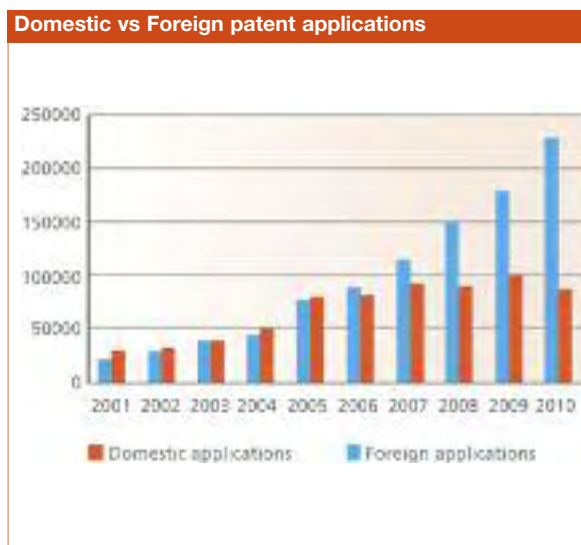


Figure 6

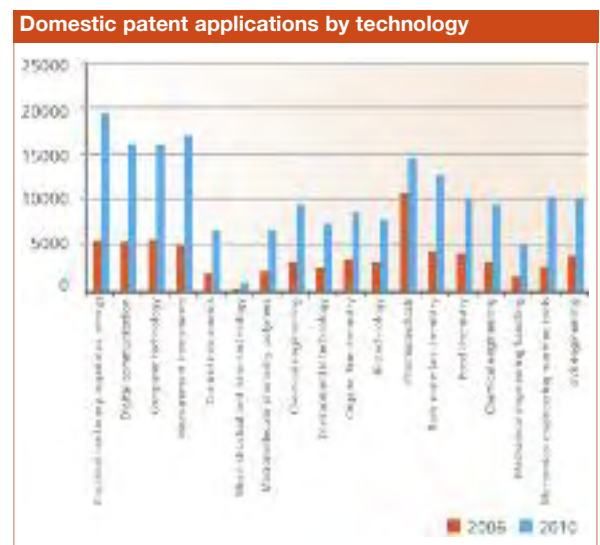


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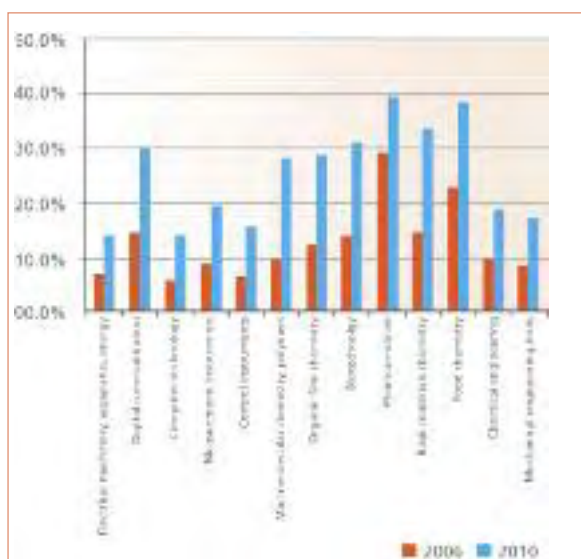


Figure 8

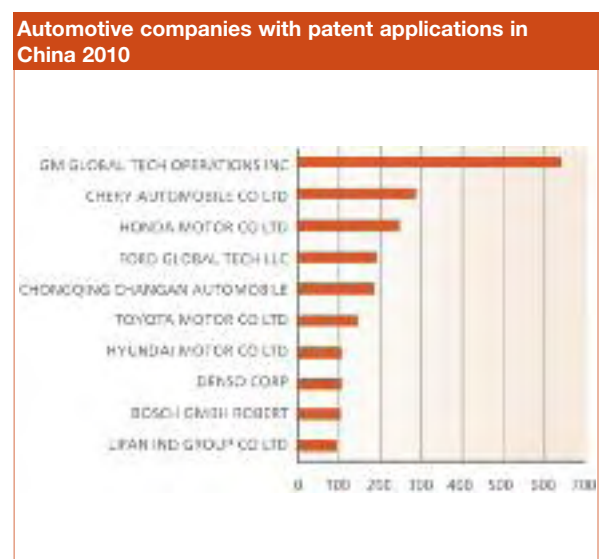


Figure 9

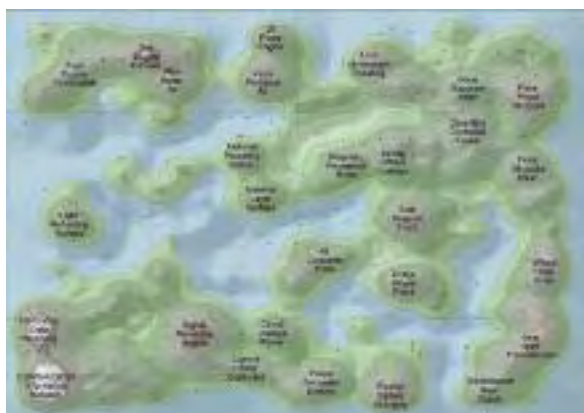
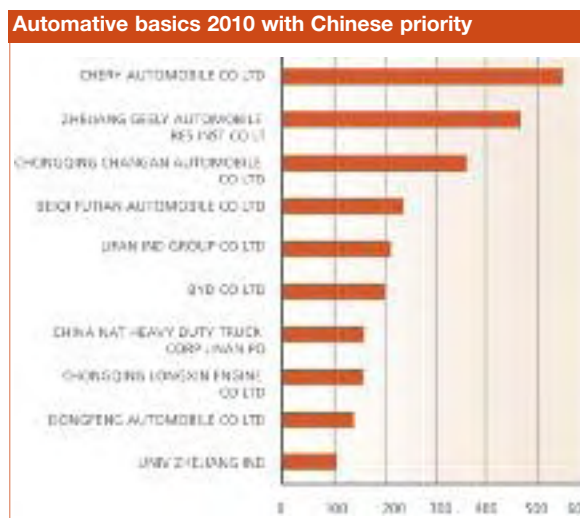


Figure 10



applications in 2006 to 17,126 in 2010) and 34.6% (from 2,007 applications in 2006 to 6,587 applications in 2010), respectively. Domestic applications grew 24.5% faster than global applications annually.

Chemistry

Microstructural technology and nanotechnology, macromolecular chemistry and polymers, chemical engineering and environmental technology grew at a CAGR of 36.8%, 32.8%, 32% and 31.2%, respectively. The global share of pharmaceutical domestic Chinese patent applications grew from 29.2% to 39.3% from 2006 to 2010, while the global share of food chemistry patents grew from 22.8% to 38.1% over the same period. Organic fine chemistry domestic applications grew 23.3% faster than global applications annually.

Other fields

In mechanical engineering, handling and machine tools grew at a CAGR of 35.9% and 40.4%, respectively, while in civil engineering domestic applications grew at a CAGR of 26.7%, rising from 3,696 applications in 2006 to 10,213 in 2010.

Technology landscapes

Further in-depth analysis was conducted for two specific technology sectors – automotive and pharmaceutical – to help to identify significant trends for these areas.

Automotive sector

A search to retrieve all basic patents (ie, the first instance of an invention) published in China in 2010

within the automotive sector was conducted using DWPI on Thomson Innovation. This data set was then analysed in two ways:

- basics with a Chinese application in the patent family; and
- basics with Chinese priority.

Domestic and foreign filings

Of the top 10 companies in China in 2010 based on basic patent publications (Figure 8), three each are Chinese and Japanese, followed by the United States (two), and Germany and South Korea (one each). GM Global Tech Operations Inc tops the list with over 600 basics in 2010.

The Chinese automotive companies in this list are notable for their rapid rise in prominence. Although the other companies are longstanding concerns, the Chinese companies were all founded in the late 1990s: Chery Automobile was founded in 1997, the modern incarnation of ChongQing Changan Automobile was formed in 1997 and Lifan Ind Group was founded in 1997 as a motorcycle manufacturer, with car production beginning only in 2006.

The Chinese automotive landscape based on basics published in 2010 is mapped out in Figure 9

There are significant clusters for fuel, engine combustion and exhaust technology, transmission and electric vehicle technology, but the most densely populated areas are around innovation in automotive information and communication technology. On closer inspection, a significant part of patenting in this area is for navigable map technology with real-time updating of traffic information with Chinese company Beijing

Figure 11



Figure 12

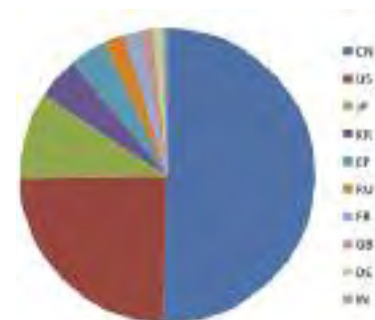


Figure 13

Year	All pharma	Traditional medicine	Non-traditional
2006	10,799	6,967	3,832
2007	12,658	8,513	4,145
2008	12,246	7,820	4,426
2009	12,833	7,798	5,035
2010	14,005	8,111	5,894

CenNavi Technologies Co Ltd featuring a number of patent applications in this field.

Domestic filings

In terms of domestic activity (based on basics with Chinese priority published in 2010), in addition to the prominent Chinese automobile companies described above, some other notable organisations appear (Figure 10). BYD Co Ltd is the largest global supplier of rechargeable batteries and has the largest market share for nickel-cadmium batteries. The auto division, BYD Auto, leads the field of electric vehicles with unique technologies.

Domestic automotive innovation is mapped out in Figure 11.

Note the prominent clusters around electric vehicle technology and circuit power control, and around more traditional engineering technology in the area of frames, plates and seat fixings, as well as gear and wheel driving shafts.

Pharmaceutical sector

An analysis of the global distribution of pharmaceutical patent applications in 2010 shows that China was responsible for just over 50% of all pharmaceutical patent applications published worldwide in 2010 (Figure

12). However, a large proportion of these were traditional medicine patent applications.

To determine the relationship between traditional medicine and 'Western' pharmaceutical patenting, the patenting trends for Chinese domestic pharmaceutical inventions were analysed for 2006 to 2010, both with and without the traditional medicine inventions. All domestic Chinese patent applications for the period 2006 to 2010 within the pharmaceutical sector were retrieved using DWPI on Thomson Innovation (Figure 13).

China accounts for between 70% and 75% of the world's patents in traditional medicine. However, its contribution to Western-style medicine is increasing at an average annual growth rate of nearly 13%, from 14.3% in 2006 to 23.3% in 2010.

Of the top assignees in the pharmaceutical sector, seven of the top 10 organisations are academic institutions (Figure 14).

Looking outwards

Chinese patent applications abroad are still at low levels, but are growing steadily (Figure 15).

For the first time a Chinese company, Huawei Technologies, topped the list of applicants to the World Intellectual Property Office (WIPO) in 2008. However, it

slipped to second position behind Panasonic in 2009, and in 2010 Huawei was placed fourth behind Qualcomm (United States, third), ZTE Corp (China, second) and Panasonic (Japan, first).

Patent Cooperation Treaty (PCT) filings originating from China are growing steadily (Figure 16).

According to a 2010 WIPO report, they are experiencing the fastest growth rate of applications from any region in the world (Figure 17).

Looking more closely at PCT applications published by WIPO gives a view on how Chinese organisations intend to protect their innovations more broadly into international markets. The majority of WIPO filings are passed on to the Chinese patent office to be processed as Chinese national patent applications, but significant numbers also pass through to the US, European, Australian, Japanese and Korean patent offices to be processed as national patents in these regions (Figure 18). Therefore, it is clear that China is beginning to look outwards to the broader international arena for protection of its indigenous innovation.

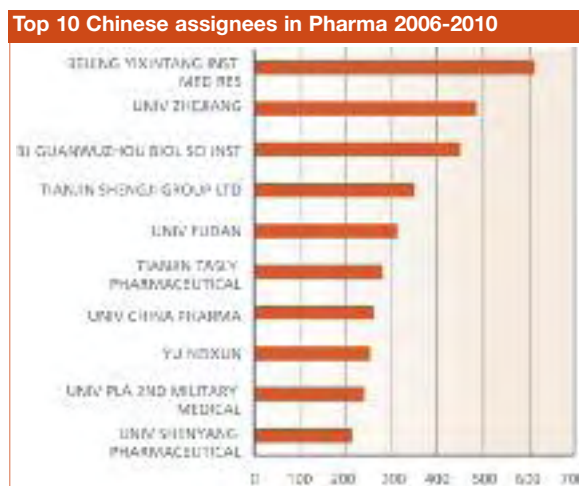
Driving forces behind the patent boom

The 12th Five-Year Plan for National Economic and Social Development was released in 2011. In this plan the Chinese government lays out its strategic vision and direction for the development of China up to 2016.

A key strategic priority laid out in the plan is for China to transition from 'Made in China' to 'Designed in China'. This is part of a long-term strategy to transform China from a manufacturing to an innovation economy. To support this goal, there are plans to develop further China's IP rights system and for heavy investment in science and technology education and R&D through development in seven 'strategic emerging industries'. These are:

- new energy – nuclear, hydro, wind and solar power;
- energy conservation and environmental protection – energy reduction targets;
- biotechnology – drugs and medical devices;
- new materials – rare earths and high-end semiconductors;
- next-generation information technology – broadband networks, internet security infrastructure and network convergence;
- high-end equipment manufacturing – aerospace and telecommunications equipment; and
- clean energy vehicles – battery cell technology with a target to produce one million electric vehicles a year by 2015.

Figure 14



There are plans to spend more than Rmb4 trillion on these industries over the next five years, with a view to increasing the strategic emerging industries' share of GDP from around 5% in 2011 to 8% by 2015.

The drive for domestic innovation continues with the implementation during 2011 of the 12th National Five-Year Plan on Science and Technology Development, which also sets out a number of ambitious goals for the further development of China as a technologically advanced nation:

- increase in R&D expenditure as a proportion of GDP from 1.75% in 2010 to 2.2% in 2015;
- improvement in the ranking of citations in international science papers from eighth to fifth; and
- increase in invention patent ownership per 10,000 head of population from 1.7 to 3.3.

Measures to support this growth in indigenous innovation include:

- research and development investment in science and technology aimed at achieving key breakthroughs in targeted technology subsectors (eg, core electronic devices, integrated circuits, life sciences, space, marine, earth sciences and nanotechnology);
- IP improvements through efforts to strengthen creation, use, protection and management of IP rights; and
- incentives through fiscal and financial policies that support high-tech industry, including updating management of research funding and systems for venture capital investment.

The recently published Chinese National Patent Development Strategy (2011-2020) also sets some

Figure 15

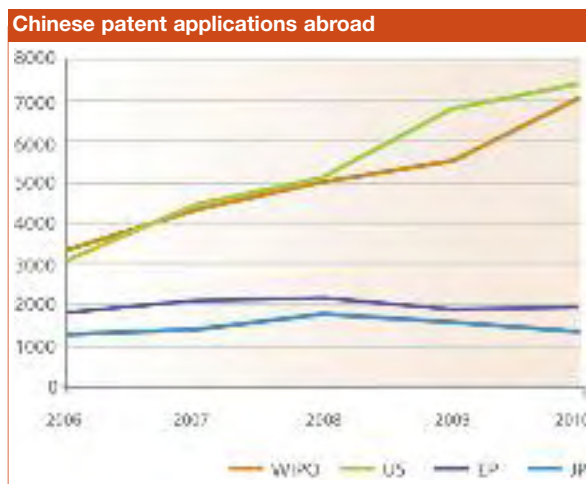
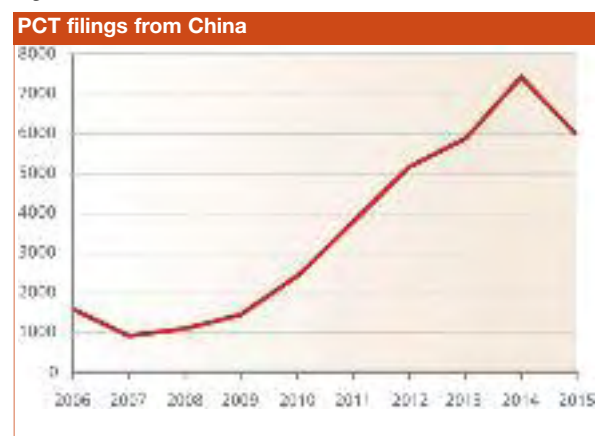


Figure 16



additional specific patent targets, including the goal that “by 2015 the annual quantity of applications for patents for inventions, utility models and designs will reach two million”. At current rates, China is set to reach 1.86 million publications by 2015, so this seems to be a realistic yet challenging target (Figure 19).

Other specific targets for achievement by 2015 are laid out in the patent development strategy, including the following:

- Annual invention patents granted to domestic entities shall rank within the top two in the world.
- The number of invention patents owned and external patents applied for every million people will be doubled.
- The ratio of patent applications by industry enterprises above a designated size will reach 8%, and the number of patents owned will be increased considerably.
- Driven by national strategic demand, a group of essential technology patents will be pre-deployed in critical areas to support emerging industry development and the industry structure adjustment.

Figure 17

Country of origin	2005	2009	Growth rate (%) 2005-2009
United States of America	46,858	46,079	-0.4
Japan	24,870	29,807	4.6
Germany	15,987	16,732	1.1
Republic of Korea	4689	8049	14.5
China	2512	7906	33.2

Figure 18

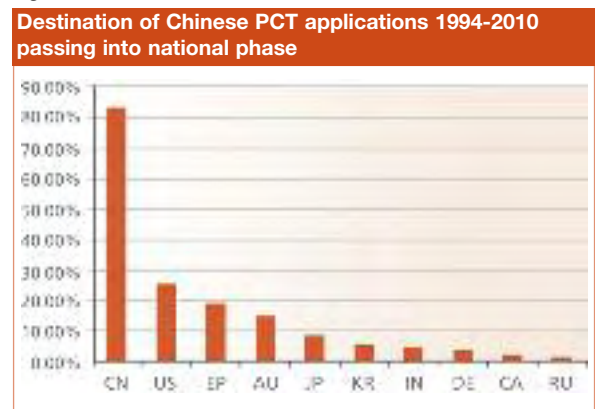
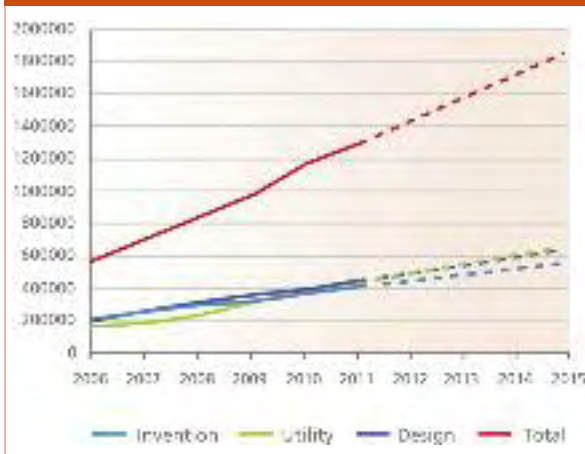


Figure 19

China invention, utility model and design patent application projections to 2015



Comment

Thomson Reuters 2008 “Patented in China” report projected that China would become the top global publisher of invention patent applications by 2012. From the revised projections in this report, that milestone is due to be passed by the end of 2011, one year ahead of predictions. This will occur not by accident, but very much by design. The five-year plans focus on driving change in the economy to ensure that in future, prosperity is increasingly built on innovation, as well as continuing to generate wealth through being the world’s major goods manufacturer. Increasingly, that innovation is being fuelled by home-grown research and development, with nearly 73% of published Chinese invention patent applications originating from China in 2010. The latest five-year plan specifically sets a target for 2015 of a combined total of two million invention, utility model and design patents (which, from current figures, is a challenging yet achievable target) and a target to double patent ownership per 10,000 people from 1.7 in 2010 to 3.3 in 2015.

This indigenous innovation is also being channelled into specific technology areas and while the major growth over the past five years has been in the areas of electrical machinery apparatus and energy, digital communications and computer technology, we can expect continued growth in these areas as well as in the seven strategic emerging industry areas laid out in the latest five-year plan.

Whatever the future holds, it is clear from the targets laid out in the five-year plans that innovation in general, and patents in particular, form a central plank of China’s strategy for future prosperity.



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Bob Stembridge graduated from University of Sussex with an honours degree in chemistry. He joined Derwent (one of the founding components of the Thomson Reuters IP Solutions) in 1980 and has held various roles in editorial, marketing, sales and product development. After leaving in 1988 for interludes working as a senior information analyst specialising in patent analytics at British Petroleum and a European sales liaison with Dialog, he returned to Thomson Reuters in 1996 and most recently became customer relations manager, with responsibility for liaison with customer user groups for the organisation.

He is a member of various groups and is secretary of the Confederacy of European Patent Information User Groups and current chair of the Chartered Institute of Library and Information Professionals Patent and Trademark Group.