

Inventions & Patents

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Asia takes lead in rush to monetise innovations

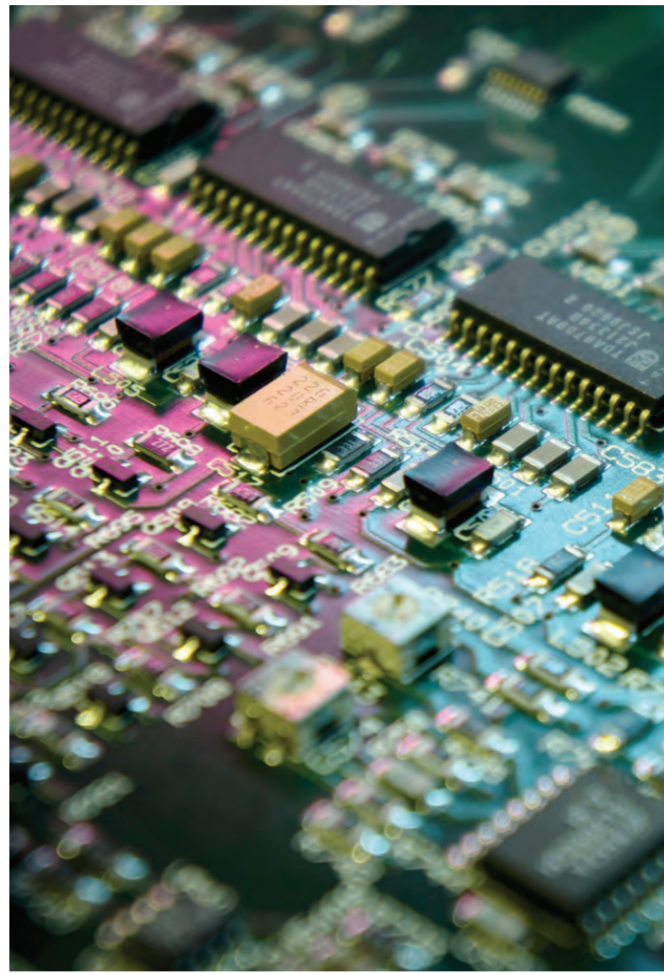
Chinese applications have risen 30-fold this century as patenting worldwide achieves new highs, says *Clive Cookson*

(WIPO) reported a 1.7 per cent increase to 218,000 in filings under the Patent Cooperation Treaty (PCT) which provides some international harmonisation. These numbers conceal a strong tilt towards Asia, which has more than doubled its share of PCT applications since 2005 and accounted for 43 per cent of last year's global total.

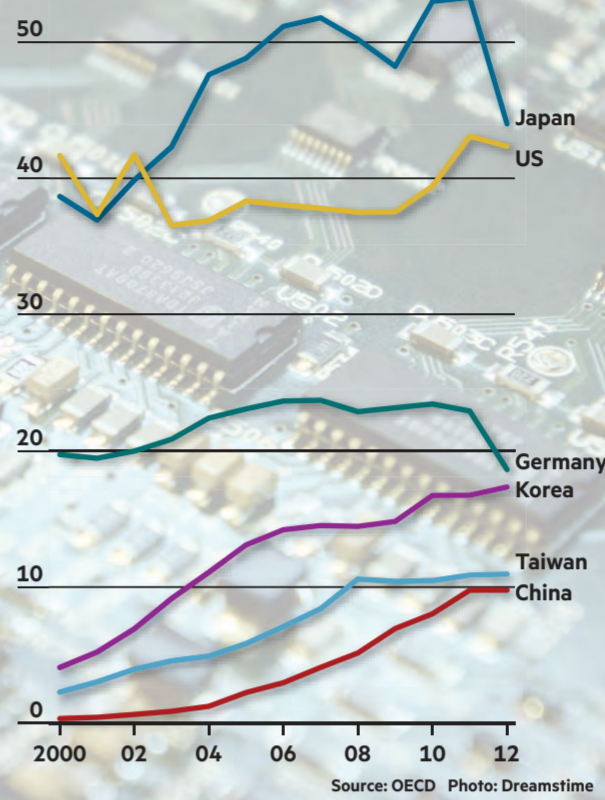
Within Asia, the big story is China, which has experienced much the fastest growth in patenting of any large country since the start of this century. Although this does not come as a surprise, given the speed of Chinese industrial development, the figures are still remarkable.

Statisticians at the Organisation for Economic Co-operation and Development have analysed for the FT the geographical distribution of patents filed in the world's five most important IP offices (Europe, US, Japan, China and South Korea) – so-called IP5 patents. In 2000, just 331 IP5 applicants were based in China; this had risen to 9,767 in 2012.

“While the Chinese growth rate in patenting since 2000 does stand out, it started far behind its competitors,” says



Where patents come from
Applications filed ('000) by six select countries at the world's top five intellectual property offices (US, Japan, Europe, China and South Korea)



Mariagrazia Squicciarini, OECD patent specialist. Mainland China had not caught up with Taiwan by 2012 and the Asian powerhouses of Japan and Korea are still well ahead in absolute numbers. “Japan has always had a positive attitude towards IP rights embedded in its business culture,” she adds. China does not have such a tradition but “there is an active policy by the Chinese government to foster patenting”.

Although more recent data are available from WIPO, EPO and other offices, Ms Squicciarini says their conclusions about applicants' country of origin must be treated with caution, because names on IP documents are not a reliable guide

to ownership. Further investigation is also needed on the industrial sector in which the applicant wishes to apply the patent.

“There is a shortage of good data about patenting, which has hindered analysis of innovation policies,” she says. The OECD team has attempted to nail down ownership by scrutinising patent office data with the Orbis global database of 200m private companies worldwide.

A striking feature of Chinese patenting is that it is distributed much less evenly across different fields of activity than that of other big countries. More than 85 per cent of China's IP5 patents

are in telecommunications, computing, digital communications and audiovisual technology. In areas such as chemicals, pharmaceuticals and biotechnology China is hardly represented.

Most Chinese patents do not reach the international arena – and are therefore not counted in the OECD or EPO data. The vast majority are filed only domestically: WIPO's World Intellectual Property Indicators report in December showed that China's State Intellectual Property Office (SIPO) received a staggering 928,000 patent applications in 2014. It was followed by the US (579,000), Japan (326,000), Korea

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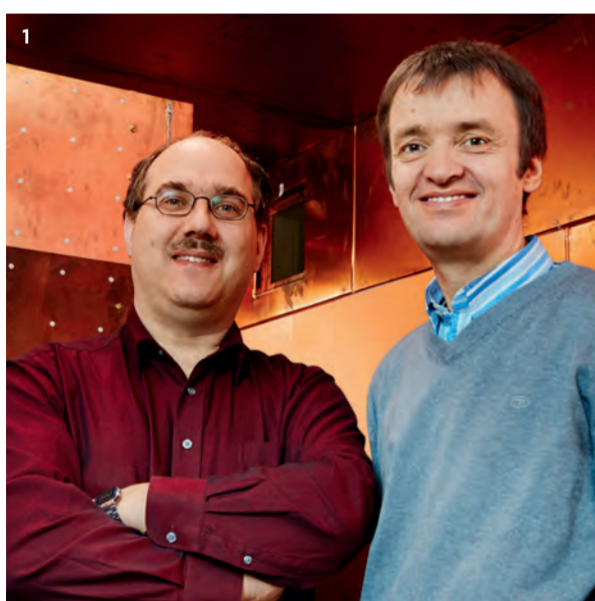
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'Spin-in' investments give incumbents direct access to start-up skills

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EUROPEAN INVENTOR AWARD 2016

THE EUROPEAN PATENT OFFICE CONGRATULATES THIS YEAR'S WINNERS



INVENTORS ARE THE HEROES OF THE 21ST CENTURY ECONOMY

Innovation creates competition, dynamic markets, jobs, prosperity and growth. Ingenious inventions in such technologies as healthcare, transport and communication can improve our lives and protect our environment. Inventors are the champions of progress, refusing to accept the status quo and harnessing the forces of nature to create new products and processes.

The European Patent Office protects inventions with patents. From a field of many thousands of patentees, the European Inventor Award recognises – for the eleventh time – truly exceptional individuals or teams.

These inspirational inventors secure our future. Many of them dedicate their entire lives to improving ours. We thank them for their contribution to technology, society and the economy.

THIS YEAR'S WINNERS

- INDUSTRY 1** Bernhard Gleich, Jürgen Weizenecker and team Magnetic Particle Imaging (MPI)
- RESEARCH 2** Alim-Louis Benabid Treatment for Parkinson's Disease
- SMEs 3** Tue Johannessen, Ulrich Quaae and team Ammonia storage to reduce NO_x
- NON-EUROPEAN COUNTRIES 4** Robert Langer Targeted anti-cancer drugs
- LIFETIME ACHIEVEMENT 5** Anton van Zanten Electronic stability control for cars
- POPULAR PRIZE 6** Helen Lee Diagnostic kits for developing countries



EUROPEAN INVENTOR AWARD 2016

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Inventions & Patents

Medical advances made despite big business

European Inventor Awards Scientists find alternative routes to market. *Andrew Jack reports*

We wanted something that anyone who can cook can use," says Helen Lee, winner of the popular prize in the European Inventor Awards. The head of Diagnostics for the Real World holds a series of patents for devices that allow simple "point of care" detection and monitoring of infections including HIV in remote parts of lower income countries.

The Samba (simple amplification-based assay) technology she has developed involves complex chemical testing using nucleic acid. Yet it delivers an uncomplicated result in the form of one or two easy-to-read lines from a device resembling a coffee machine with simple cartridges. Mobile phones share the findings. "Rather than force-feeding developed world technology into the developing world, we set it up the other way round — although it is designed to be good enough for use in richer countries," says Dr Lee.

European patents are dominated by innovations in the medical sector, but it is not just about drugs and diagnostics. The implementation is as important as the innovation itself. "The patent is just

one part of the chain," says Dr Lee. "It only takes one weak link and it will not work. I always said engineers can't develop something without visiting the clinics where it functions."

Alongside the difficulties in poor countries of electricity outages and voltage surges, she highlights extreme temperature ranges — from above 38 degrees centigrade in Malawi, to the chilly conditions of Johannesburg in winter. The new Samba II device under test is designed for such a greater range.

"One of the biggest constraints is dust," says Dr Lee. "It's pervasive and clogs up the electronics." She also cites the problems of spare parts — one reason she developed a filter that can be washed and reused.

Dr Lee previously worked at Abbott Laboratories, the US healthcare products group. But she explains that the time and nature of the diagnostic would have been difficult to develop in a large company, so she created her own. "If I'd still been at Abbott I would have been fired a long time ago. In fact, I would have fired myself because you can't do this in two to three years."

Working outside large companies has also been key for Tore Curstedt from the

Samba time: Dr Helen Lee with her simple testing device

Karolinska Institute in Sweden, who, together with fellow researcher Bengt Robertson, developed a treatment to prevent the lungs of premature babies from collapsing. Key to this was Mr Curstedt's initial work in the 1960s on phospholipids, a component of cell membranes, and in the early 1980s he joined with Mr Robertson to explore the potential for surfactants — naturally occurring substances in the alveoli of the lungs.

They concentrated on the potential to treat neonatal respiratory distress syndrome; their surfactant preparation has been administered to 5m newborns over the quarter of a century since its launch. "We became very focused, building a network of neonatal doctors and holding expert meetings every year," he says.

The surfactant is extracted from pigs' lungs and prepared in their laboratory. The academics needed an industrial partner, but Mr Curstedt says that Pharmacia, a Swedish drug company which has since become part of Pfizer, felt "the sales were too small and the marketing costs too high".

Instead they came across Chiesi, a small Italian pharmaceuticals business.

"It was an important product in a small company instead of a marginal product in a big one," he says. The company named the surfactant Curosurf after the two inventors and continues to dominate production.

Robert Langer, a professor at the Massachusetts Institute of Technology, has won the European Patent Office's non-European award for a system that envelops anti-cancer drugs in biodegradable plastics to give them maximum impact. He recalls early in his career being the only engineer in a hospital. "I was so naive at first. I thought if I published papers, people would read them and that would lead to products. . . . The big companies didn't use them, so I started small companies to develop them."

He remains committed to a series of projects: targeted delivery of therapies; tissue engineering; and exploring longer term release of drugs and vaccines to ensure patients more reliably follow treatments in lower income countries. "I want to take first world technology to the third world," he says. He argues that "the patent system is critical. Without protection, investors would certainly not put significant money into my area, biotechnology."

'If I'd been at Abbott I would have been fired. In fact, I would have fired myself'
Helen Lee, head of Diagnostics for the Real World

Asia takes lead in rush to monetise inventions

Continued from page 1 (210,000) and the European Patent Office (153,000). The WIPO figures indicate that Chinese inventors filed only 36,700 applications outside China in 2014 — far behind the number from the US (224,000), Japan (200,000) and Germany (106,000).

Many foreign companies are reluctant to patent in China, explains Mark Schankerman, intellectual property expert at the London School of Economics, "because it has been almost impossible to enforce patent claims through the Chinese courts".

Prof Schankerman compares China's attitude today with that of the US in the early 19th century. "Americans were then ripping off IP from the UK because they were consumers rather producers of technology," he says. "Now the US is in the vanguard of producers and the Chinese are like the old Americans."

The Chinese market is so big that international companies cannot afford to ignore it and increasing numbers are protecting IP in China.

Prof Schankerman predicts that Beijing will soon encourage this trend by increasing enforcement. "One reason is that it wants to encourage foreign investment, which will not come if IP is systematically stolen," he says. "The other reason is that China is moving from being a low-wage consumer to become a producer of technology."

Analysis of different fields demonstrates an increase of IP5 patenting in most physics-based sectors such as computer technology and digital communication. Patents based on chemistry and biology are in decline, including pharmaceuticals and biotechnology.

These differences stem partly from faster technical advances and market growth in information and communications technology (ICT) than in the life sciences — and partly because of struc-

Ready for self-updating business cards and tickets?

Microprocessors

Turning paper products from labels to medicine packs into interactive devices is becoming close to reality, says *Peter Wise*

What if, rather than ordering new business cards when you change jobs, you could just update your existing card directly? Or if you could dial up a new colour of wallpaper when you grew bored of the old?

Turning everyday paper products into interactive devices is becoming a possibility thanks to the work of Elvira Fortunato and her husband Rodrigo Martins, the Portuguese inventors of paper transistors. As the electronic book and online newspaper threaten to turn paper into mere packaging, their research promises a new future for a 2,000-year-old material.

A director of the Materials Research

Centre (Cenimat) at Lisbon's Universidade Nova, Prof Fortunato began looking at paper as a support material for transistors, the "Lego bricks", as she puts it, that provide the computing power in almost every electronic device.

Her breakthrough came with the discovery that paper could function in a transistor as an active component. "A transistor needs insulating, semi-conducting and conducting material to work," she says. "Our innovation was to show that paper could provide the insulating component."

Deploying zinc oxide, another cheap and abundant substance, as a semiconductor, and aluminium as the conductor, the team used photocopy paper and an adapted ink-jet printer to make its first transistor. "I thought the probability of success was very low, but it worked first time," says Prof Fortunato.

Since publishing their results in 2008, the team has been working on potential industrial applications. It is now a candidate to run a €20m European pilot project to manufacture paper chips. "In two to four years, Europe could see the

birth of an electronic paper industry," says Prof Martins.

Their aim is develop low-cost, disposable applications to complement rather than replace silicon chips. The latter are more efficient, but also far more expensive and environmentally damaging to produce. Up to 80 per cent of naturally-occurring silicon is lost in the manufacture of chips, which requires high temperatures, clean rooms and the use of toxic gases.

Paper microchips, by contrast, can almost be made at home, says Prof Fortunato. They use about 1,000 times less material, can be produced at room temperature at a fraction of the cost and are entirely recyclable and disposable.

Intelligent labels, including interactive shipping tags and remotely updatable supermarket labels, are high on the list of potential uses, along with self-updating plane tickets, business cards and food labels. Worried that an elderly relative may have forgotten to take their medication? Packets of tablets could soon alert you by electronic message.

Brutal economics 'will defeat the hackers'

If you have used a mobile phone or a credit card, then you should thank Joao Daemen and Pierre-Yvan Liardet for making them safer, writes **Duncan Robinson**.

The Belgian and French cryptologists, who were among the finalists for the European Inventor of the Year awards, are responsible for rethinking the chips found in sim cards and credit cards.

Before their breakthrough, these chips suffered from a major flaw. Each chip stemmed from a "master card", which — if it fell into the wrong hands — could be used to clone other cards in a bank's network.

If this happened, then the companies that issued them — ranging from mobile phone operators to the world's biggest banks — had little choice but to scrap all the cards stemming from the master card and send out new ones.

With about 9bn cards in circulation, this could prove expensive and inconvenient. The solution devised by the duo who work at Franco-Italian chipmaker STMicroelectronics, was simple.

Their idea was that a master card should be able to communicate with a user's card only once, when it sends an

encryption key to the new card. Once the card has responded, and the data has been transferred, the channel is closed and cannot be accessed again — even by the master card. While this does not stop hackers from being able to access the master cards, it makes it practically pointless to do so.

In the end, it is brutal economics that finally defeats hackers, says Mr Daemen.

While the costs of security should plunge thanks to such inventions, the cost of trying to break safeguards should increase, meaning that "the adversary has to spend a billion to deliver himself millions". "We have to remove the business case of the attacker," declares Mr Daemen.

This is how he sees his role at STMicroelectronics. "It is a process of trying continuously to improve the security and make it more cost effective," he explains.

While the technology behind "chip and pin" cards has been the norm in Europe for a while, it is only now becoming common in the US.

"There is a big investment to migrate to chip cards," says Mr Daemen. "It would cost more to migrate than the frauds we are having. But the frauds are going up."

928,000

Applications in 2014 to China State Intellectual Property Office

30-fold

Increase in number of IP5 Chinese patents from 2000 to 2012

tural differences between them. "ICT products are becoming ever more complex," says Ms Squicciarini. "To get a smartphone on the market you may need hundreds of patents. And think about the digitisation of the economy — think of all the electronics going into cars, for example."

"In 'non-complex' technologies such as pharmaceuticals very few patents are needed on a product," adds Prof Schankerman. "For a drug one patent may be enough. In contrast, complex IT products are surrounded by 'patent thicket'." Companies obtain patents to use as bargaining chips and give them freedom to operate in a field such as smartphones or computers."

Not surprisingly, the companies most active in the patenting arena are all in electronics and IT — and the top seven are based in Asia, according to the OECD's analysis of corporate patents between 2010 and 2012. General Electric of the US comes in at number eight, while the highest placed European company is Robert Bosch at 12. All are well-known household names with the exception of Taiwan's Hon Hai Precision Industry, the global electronics industry's largest contract manufacturer, which filed 3 per cent of IP5 patents.

Brexit vote would harm EU unitary patent plans

Legislation

A British exit would delay the birth of a common system and cost UK hosting rights, says *Clive Cookson*

The long-awaited single European patent, protecting inventions throughout the EU, is set to arrive next year — unless Britain votes to leave the bloc in this month's referendum.

A Brexit vote would seriously wound the new "unitary patent" and its associated "unified patent court" (UPC). Having played a big role in developing both institutions, Britain would have to withdraw from the UPC and forgo hosting a division of the court ruling on life sciences and pharmaceuticals disputes. Under current agreements, the unitary system can only come to life if ratified by a minimum of 13 nations including France, Germany and the UK, the EU's three biggest patentors. "I don't think Brexit would necessarily torpedo the

whole thing," says Rob Williams, co-head of intellectual property in the London office of Bird & Bird, the international law firm, "but it would certainly delay its introduction while new arrangements are made."

"A UK exit would undoubtedly unleash a political crisis within the EU," says Allen & Overy, another global law firm. Yet it argues that because "the UPC has developed a commercial momentum of its own", it could be still be launched next year "if there is sufficient will to solve the practical issues". There would be no shortage of offers to take London's place as home to the new court's life sciences branch.

If Britain votes to remain in the EU, all seems set for

the system to begin operating next May.

That is well behind the starting dates suggested by some UPC enthusiasts in 2012, when the EU finally agreed the new system. But that new date had appeared realistic until the UK vote was called.

The novelty of the unitary system does not lie in the way patents are examined and granted. The European Patent Office, a non-EU international organisation that has operated from Munich since 1977, will administer the unitary patent on behalf of the EU as it has a European patent until now. Applicants will also retain the option to register their patent in individual countries instead.

The new system brings two changes: first is the automatic validation of a unitary patent in all the

countries that have ratified the system at the time a patent is granted. Also novel is the legal framework to adjudicate on disputes, which combines elements of Europe's different legal traditions. Its decentralised structure has a Court of First Instance for initial hearings with a central division in Paris and branches in London and Munich. The Court of Appeal will be in Luxembourg. Other facilities, such as arbitration and training, are to be distributed around Europe.

Recruitment of judges for the pan-European system is going well, says Daniel Brook, a partner in the London IP group of Hogan Lovells, the international law firm. "The initial round had over 1,500 applicants," he says, "which should mean that we get some good judicial appointments." The system will eventually require a few hundred judges, many working part-time. A net salary of €11,000 a month exceeds that offered by national systems.

Meanwhile the big IP law practices are assessing their clients' enthusiasm for unitary patents. Allen & Overy's just completed survey of 151 patent special-

ists in European companies found that "many are ready for the launch next year. They have put people and processes in place and have started working out what the unitary patent could mean for their business and how best to respond."

Strategies vary according to a company's size and activities. "Sectors like life science/pharmaceuticals, which depend on a few crown jewel patents for the bulk of their business revenues, look set largely to opt these few patents out of the UPC system," the study found. Until they see how it is working, these companies may not want to risk having key patents struck down throughout the EU; under the existing system, a loss in one country is not a Europe-wide setback.

"Industrial companies and those in the technology, media and telecoms field, on the other hand, are more likely to leave a sizeable number of important patent suites in the UPC system, where they can test the viability of pan-European injunctions and ensure the system develops with their input."



Timing: Brexit would delay unitary system

Contributors

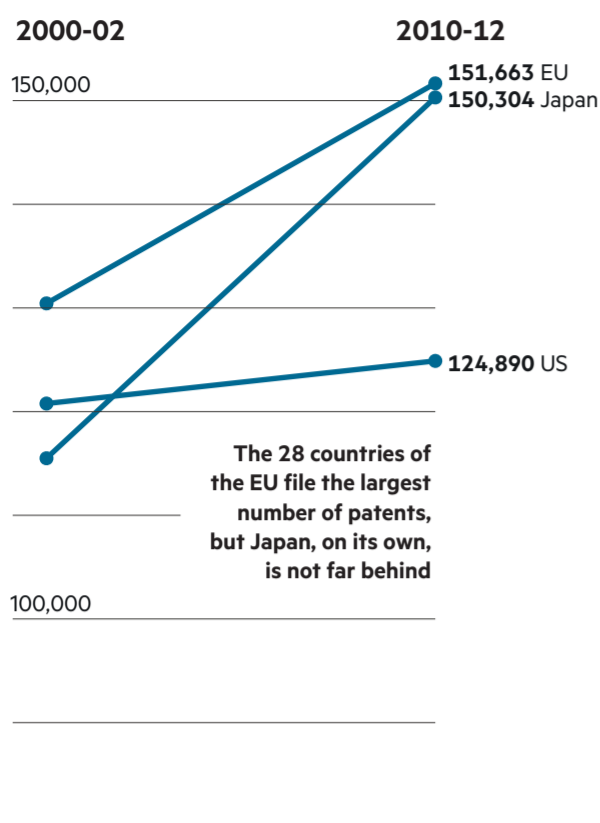
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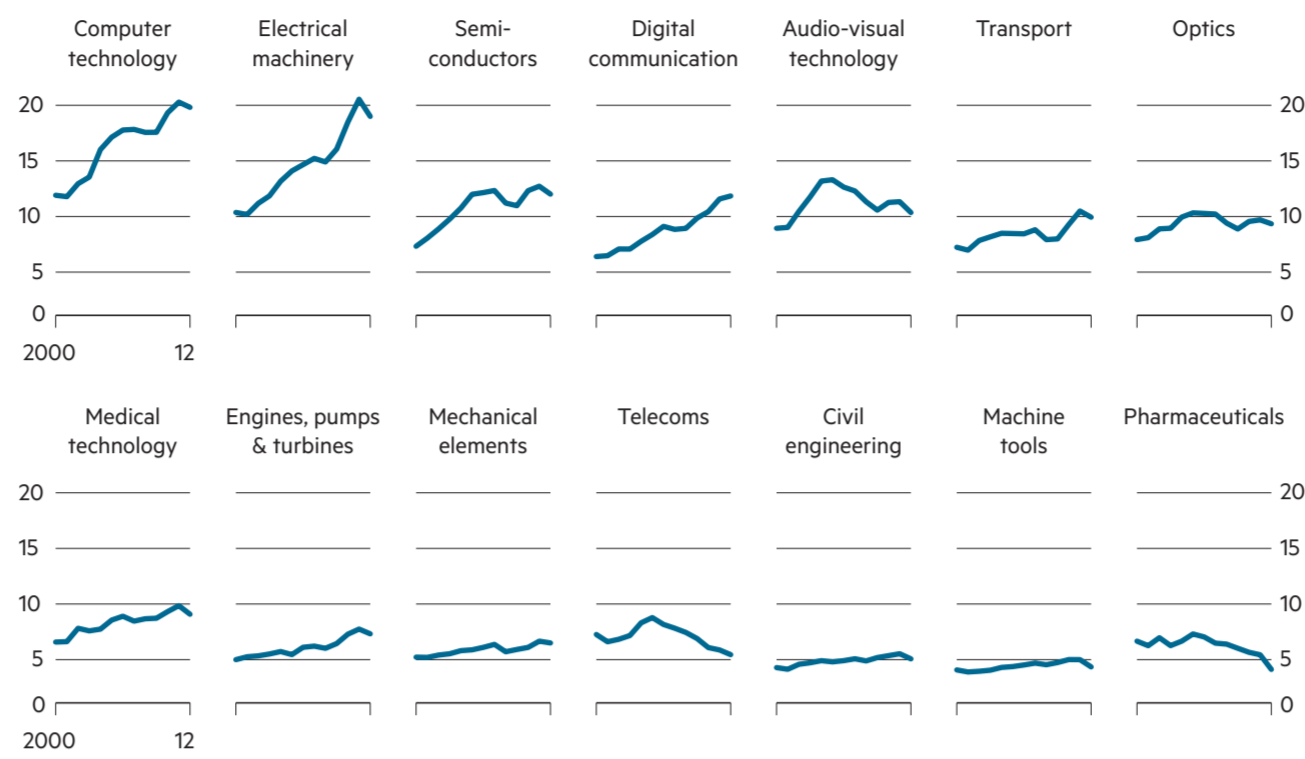
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Worldwide patent trends

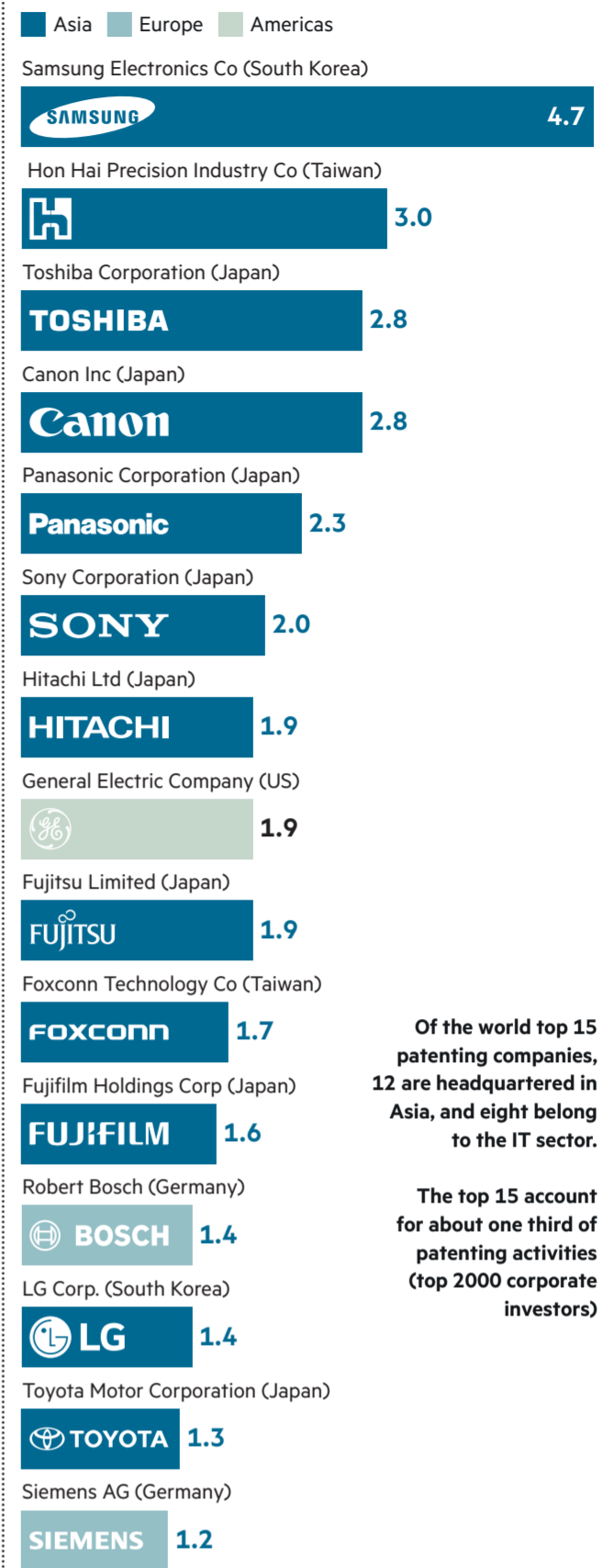
Patents filed by country of applicant
Number of applications to the top five IP offices (IP5)



Patents filed by sector
Number ('000) of applications to the IP5 in selected categories

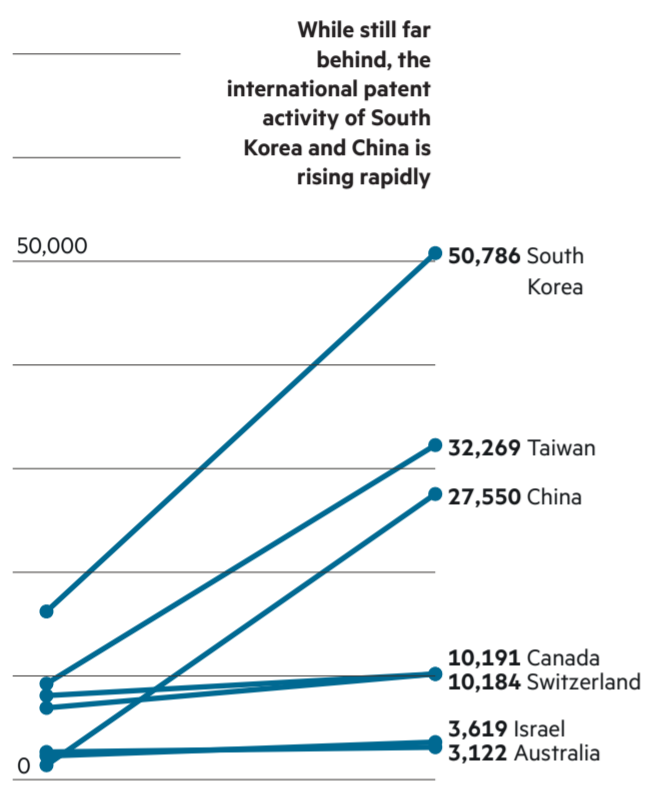


Top patenting companies
Share of IP5 patents of top 2000 R&D corporations, 2010-12*



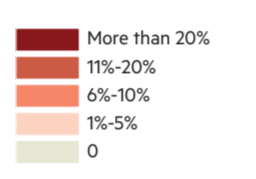
Of the world top 15 patenting companies, 12 are headquartered in Asia, and eight belong to the IT sector.

The top 15 account for about one third of patenting activities (top 2000 corporate investors)



Specialisation by country and sector

% IP5 patents 2010-2012 (filed by top 2000 corporations in selected technologies) so for example 9% of applications with IP5 offices by selected EU companies were in electrical machinery



International patenting activity in Europe and the US is spread across a wide variety of sectors, including health and the environment. Companies based in Korea, China and Japan show a higher specialisation in IT

	EU	US	Japan	South Korea	China	Rest of the world
Electrical machinery	9	6	11	13	4	12
Transport	8	5	5	4	1	1
Digital communication	7	7	4	9	52	6
Engines, pumps, turbines	7	6	3	1	0	1
Measurement	6	5	4	2	1	5
Computer technology	6	15	9	16	15	17
Medical technology	5	6	3	1	0	1
Mechanical elements	5	3	2	1	1	2
Semiconductors	3	5	8	15	1	9
Organic chemistry	3	2	1	1	1	2
Basic chemistry	3	3	2	1	0	1
Other special machines	3	2	2	1	0	1
Machine tools	3	2	2	0	1	2
Telecommunications	2	2	3	5	11	4
Audio-visual tech.	2	4	8	11	4	11
Polymers	2	2	2	1	0	1
Chemical engineering	2	2	1	1	1	1
Handling & logistics	2	2	2	0	1	2
Thermal devices	2	1	1	1	0	1
Control	2	2	1	1	0	2
Pharmaceuticals	2	2	1	0	0	2
Other consumer goods	2	1	1	1	0	1
Optics	2	2	9	6	1	5

FT graphic: Valentina Romei and Chris Campbell Source: OECD IP5= Top five IP offices: Europe, US, Japan, South Korea, China

* Patents filed in at least two offices including one IP5

Ensure you have more than bragging rights

Q&A How to protect your great inventions.
By Frederick Mostert

Many of us have ideas and dreams, which we hope may translate into commercial success. Increasingly, we turn to patent protection to safeguard the products of our ingenuity.

How far-ranging are patents? Patents cover any new, useful and unobvious invention. Amazon's 1-Click checkout system, Viagra, the telephone, the light bulb, Windows software, the Dyson vacuum cleaner, a novel windsurf board, Lego toy bricks, the artificial heart, cat's eye road reflectors, the computer mouse, and a unique cut of a diamond are all examples of past or current patents filed worldwide.

Patents are global and cover hundreds of thousands of products and processes you may encounter in daily life, including some types of prescription pills, flatscreen televisions, windscreens wipers, pacemakers, satellite systems, plastic products. The US Supreme Court went as far as to say, with reference to the manufacture of a living bacterium, that "everything under the sun that is made by man" is technically patentable.

Can I patent an idea? No matter how amazing your idea is, you can only protect it with a patent if you get it out of your head and turn it into a working prototype or a detailed description of an actual working thing or process that people are willing to pay for.

Why are patents controversial? In the dotcom era, protection under "business method patents" was so extreme it created a backlash against what critics call the "silliness standard". Even a golf putting method could be protected. These extreme cases are becoming fewer in number. Some also argue that a forest of patents tends to impede honest innovation, because the cost of clearing new inventions for use and patenting is often prohibitive for small and medium-sized enterprises. Some recent patented inventions have spurred disruptive business innovations and have created "new

normal" practices in some sectors. The spotlight is increasingly on those patents that corner market segments. Google, for example, has potentially started what some have called an arms race by filing patent applications covering "machine learning" which help classify, cluster, organise and prioritise documents.

The Silicon Valley saying "it's all in the algo" is especially resonant today, when there is a rush to file patents for newly invented programmes on software algorithms. Algorithms are strictly speaking not patentable. These filings are pushing at the edges of acceptable patent protection. This trend is likely to continue, especially where Big Data is concerned. Tyron Stading of CPA Global, a specialist in intellectual property software, says the "number of patents filed in the areas of predictive analytics, data mining and intelligence technologies have doubled in the last five years".

What can you patent? You cannot get a patent on any old thing. But show the world something new and the chances are it might be patentable. Ensure that the invention is new as in "inventive" (not just an obvious modification of something that already

Google may have started what some have called an arms race by filing applications for machine-learning



exists) and has an "industrial application" (in other words something that can be made or used). Given these criteria, some ideas are generally accepted as being non-patentable. As Sean Dennehey of the UK Intellectual Property Office explains: "Some of the things you can't get a patent for are discoveries and theories, ways of presenting information, doing business or playing games, and works of music, art or writing (which can be protected by copyright). Computer programs as such aren't patentable either, but many patents are granted for inventions enabled by computers." See also www.gov.uk/patent-your-invention/what-you-can-patent
How do you acquire a patent? Feel the need for speed. Patents are

time-critical, so stake your claim first at the patent office before your competitors beat you to the prize. It is "first in time, first in right". The one who is first past the post, wins.

Can I lose a patent right? Yes, if you publicly disclose your invention before filing. You will fall foul of the nondisclosure requirement if you publish a synopsis of your invention on your website, a chatroom, in a technical newsletter, by giving a lecture at a conference, by describing your invention to a potential customer or by bragging about it on social media. If you must discuss your invention with someone, you should ask that person to sign a nondisclosure agreement.

Patent or trade secret? While patents have traditionally been the initial default mechanism for protecting innovative ideas, "it is becoming increasingly common for companies to look at trade secret protection as an equally useful, and lower cost, IP option," says Gerry DePardo, a US trade secret lawyer. Patents do not last for ever and if your invention is of the type that people will want to use or exploit for decades, and is of the sort that people cannot reverse-engineer, it might make sense to protect it as a trade secret. Coca-Cola with Merchandise 7X, and Lea & Perrins with its sauce formula, will attest to this. In today's knowledge economy, industry sectors such as software, financial services and data analytics are no longer using patents as the only weapon in their intellectual property arsenal.

Patent litigation — deep pockets required. Keep in mind that patent cases constitute the most expensive form of litigation. Some disputes continue long after the patent has expired — as is often the case in the oil and gas, and pharmaceutical industries.

When and to whom was the first patent granted? All foodies will rejoice to learn that in 200BC, Athenaeus officially reported that the Sybarites in ancient Greece granted a monopoly to a pastry chef for his "peculiar and excellent" pastry invention.

Frederick Mostert is a research fellow at St Peter's College, Oxford, and author of *From Edison to iPod — Protect Your Ideas*

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Inventions & Patents

Tricks that help big companies change faster

Management
John Thornhill reports on how 'spin-in' investments give incumbents direct access to start-up skills

'Every industry and every country will be tech driven. GE is a tech company. Walmart is a tech company. Verizon is a tech company.'

John Chambers, executive chairman of Cisco, told an audience at the World Economic Forum in Davos earlier this year. Such was the scale and speed of technological change, he said, that every country in the world would have to become a digital country and every business a digital business.

Not so long ago, technology tended to be the concern of the chief technology officer and few others. Now, with the rise of technology-driven challengers in every industry, from Uber in transport to Alibaba in retail, it is an issue for every function across a company.

Many companies are struggling, however, to make the transition from analogue to digital and to innovate sufficiently fast. Mr Chambers suggested that one way for established businesses to acquire sufficient knowledge was a so-called "spin-in" – investing in start-up companies with innovative mindsets.

The global corporate venturing market, in which established companies invest in high-growth start-ups, has been developing fast. According to Global Corporate Venturing magazine, big companies made 1,693 investments in such deals worth \$76.4bn in 2015. This compared with 1,481 investments worth \$40.9bn the year before.

Cash-rich US companies, with plenty of money parked offshore, have been particularly active looking for such opportunities in China and Europe.

Incumbents are also buying start-up companies outright and looking to expand them quickly.

One example came in April when Accor, the French hotel group, acquired Onefinestay, the UK home-rentals start-up, for at least €148m to help



Innovating from the outside: Accor acquired Onefinestay (above) to counter Airbnb

counter the rise of Airbnb. Accor's intention is to provide the financial and managerial muscle to expand Onefinestay's presence in five cities at present – London, Paris, New York, Los Angeles and Rome – to a total of 40 within five years.

When the deal was announced, Sébastien Bazin, Accor's chief executive, said the acquisition would enable the company to accelerate the transformation of its business model and expand more quickly into the digital world. "They should rely on us for speed and scale and for financial firepower – the rest we leave to them to do what they do best," he said.

"To get to where Onefinestay is today would have taken between two and three years," he said. "It would have been a terrible idea to do it by our-

elves." But as well as trying to innovate from the "outside in", big companies are also trying to innovate from the "inside out" by promoting what has become known in ugly jargon as "intrapreneurship".

Established companies are realising that they have many assets of value in the new digital world: powerful brands, smart employees, a deep understanding of their customers, masses of data, and easy access to capital markets. But their attempts to innovate are often hamstrung by a lack of focus and long-term commitment, divisional infighting, and fear of failure.

For their part, start-up companies often have the imagination, technological smarts and entrepreneurial drive to launch a business, but often find it hard to scale their ideas. More innovative

business models, which could bring the two together, are needed. For example, Unilever has been increasingly looking to work with outside partners in its Open Innovation model.

Henry Lane Fox, who runs the Founders Forum group in London, is one of those trying to act as a marriage broker between big business and early-stage companies.

"We believe there is a massive untapped opportunity for big businesses to push their market insights and audience development skills into new business models," he says. "The mindset of many CEOs is that there are real forces attacking their core business, often from unexpected sources, and they have to respond."

To that end, Founders Factory, the group's incubator, is working with

Attempts to innovate are often hamstrung by a lack of focus, divisional infighting and the fear of failure

established companies, such as L'Oréal, Aviva, Guardian Media Group and the German publishing group Holtzbrinck, teaming them up with promising start-ups in their business sectors.

For example, L'Oréal and Founders Factory will invest in five existing start-ups and jointly launch two new companies a year to accelerate innovation. The French cosmetics group will be able to tap into the Founders Forum network of 1,500 entrepreneurs and partners to explore new business opportunities.

In total, Founders Factory is aiming to incubate 200 tech companies over the next five years.

"We have an incredible community of tech talent and capital in London," says Mr Lane Fox. "We have a lot of incredible corporate HQs too that are taking this tech world a lot more seriously."

Understanding what makes inventors tick

Psychology

Science has found common traits in the brains of the mentally ill and creative people, says Naomi Shragai

Highly creative people both intrigue and irritate us. We admire the minds of people such as Steve Jobs and Michaelangelo, marvel at their achievements, but may weary of their personalities, which can be egotistical and moody.

Technology and industry are increasingly reliant on innovation and are eager to support creative individuals. This can be frustrating, however, when the process of innovation goes against the grain of businesses that demand productivity and efficiency, and have little tolerance for errors. Creative people can be enthused about a project, only to lose interest as their attention shifts elsewhere. They need time to mull over ideas, which makes them appear to be doing very little. In their own time zone, they are often late or forget meetings, to the annoyance of managers.

Understanding their unique ways of thinking is essential to getting the best out of them. Two qualities that define creativity are divergent thinking – thinking beyond normal boundaries – and cognitive flexibility, which is the capacity to restructure ideas and see connections that others miss.

People with these qualities risk going beyond what is safe and familiar, which most of us would avoid for fear of being wrong or damaging our reputations. While most of us look for the "correct" or conventional answers, they seek novel solutions and new associations.

Many of these ideas will never come to fruition, so creative thinkers need to become hardened to disappointment and failure. Steve Jobs was famously fired and then rehired at Apple. Henry Ford filed for bankruptcy twice before finding success with the Ford Motor Company. However, their resilience and confidence in their ideas can make innovators appear arro-

gant and egotistical to their colleagues.

Science has found links between highly creative, healthy people and individuals with schizophrenia and bipolar illness, with some brain chemistry features in common. Connections have also been made between creative individuals and relatives with a mental illness, suggesting a genetic link.

Dr Shelley Carson, a lecturer in psychology at Harvard University and author of *Your Creative Brain*, says creativity and schizotypal personality features often go hand in hand because one of the underlying features for both is a propensity for cognitive disinhibition.

This means a person is less able to block out extraneous information. "They lack [cognitive] filters which the rest of us have for social appropriateness, or they have more porous cognitive filters," Dr Carson says. "So, information that most people might ordinarily suppress makes it through into conscious awareness for these people. This provides more pieces of information which can be combined, and then recombined, in more original ways to form creative ideas." She compares the insights of highly creative people to how psychotic thoughts emerge in the minds of mentally ill people.

Science has found links between innovators and schizophrenics

"Cognitive disinhibition is also likely at the heart of what we think of as the 'aha' experience. During moments of insight, cognitive filters relax momentarily and allow ideas that are on the brain's back burners to leap forward into conscious awareness," she says. Her ideas are supported by research at the Karolinska Institute in Sweden, which has shown that the dopamine system in the brains of healthy, highly creative people is similar to that found in people with schizophrenia. Dopamine receptor genes are linked to divergent thinking, inherent in creativity and also



Great minds: Michaelangelo – Getty Images

associated with psychotic thoughts. Both groups have fewer of the "D2" type dopamine receptors in the thalamus, the brain's filtering system. This enables a high flow of information from the thalamus to the frontal lobes, which are responsible for deciphering information and where thoughts become constructive and meaningful.

Ms Carson says novel ideas result from a combination of high IQ, a capacity to hold many ideas in mind, and cognitive flexibility. "When you can combine those with the ability to [cognitively] disinhibit then very often highly creative ideas result."

Gary Klein, a cognitive psychologist and author of *Seeing What Others Don't*, believes many companies have much to learn in facilitating creativity. Their first reactions to innovations are often nervousness and distrust because insights can be disruptive and can lead to errors.

If businesses are to encourage innovation they need to learn to tolerate a degree of anxiety and uncertainty. Mr Klein says managers need to ask: "What are we doing that's getting in the way of innovation?" For example, strictly adhering to a plan risks restricting the creative process, as can an emphasis on data gathering and voting by consensus.

"All you need is one or two people who become nervous about a creative idea and the team backs off and moves in a safer direction," he says. "Organisations can look to see if they are evaluating new proposals so heavily in terms of weaknesses that they kill ideas." He adds: "If you want to kill a creative idea, have an organisation that's very hierarchical, which means it has to be approved by everybody up the chain. It only takes one person in the chain to kill an idea."

Trolls rear their ugly heads in courtrooms around the world

Legal

Opportunistic lawsuits pose a real threat to start-ups, and not just in the US, writes Mackenzie Weinger

When the known "patent troll" company Lodsys sued Todd Moore over a hyperlink in the app his three-person start-up had created, the US-based software developer thought it had to be a mistake.

Like many other small business owners accused of patent infringement, Mr Moore was soon immersed in a frustrating fight. But instead of simply paying the several thousand dollars Lodsys asked for, he found a pro bono lawyer to take on the lawsuit.

Although it meant time away from improving the app, which plays relaxing sounds to lull people to sleep, Mr Moore decided to try his luck against the system – and the lawsuit was dismissed. More often, however, companies and innovators end up paying the "troll toll" in settlements and legal fees.

"I've met lots of other founders and CEOs that have been targeted," Mr Moore says. "It's frustrating every time you hear another story because it's a serious problem that isn't going away. I'm hoping the system will change and put an end to this unethical behaviour."

Litigation brought by "patent assertion entities" or "non-practising entities" made up about two-thirds of all patent cases brought in the US in 2015. These companies buy up expiring or otherwise ubiquitous patents – such as databases or shopping carts on e-commerce sites – and use them as leverage to sue small businesses, putting a severe strain on the defendants.

As Geoff Lane of the Application Developers Alliance, which supports legislation in the US to counter trolls, puts it:

"It's just this constant struggle for these small guys to figure out who is legitimately enforcing their patents and who is just trying to shake them down for a quick thousand bucks."

The damage patent trolls can cause extends beyond the legal sphere, says Professor James Bessen, economist at the Boston University School of Law. Studies suggest that it has decreased

venture capital investment in start-ups and reduced the amount companies spend on research and development.

A body of research now exists that shows patent troll litigation "is putting significant costs on innovators and innovation more generally", he says. For instance, a paper by Catherine Tucker at the Massachusetts Institute of Technology found that "VC investment would have likely been \$21.772bn higher over the course of five years but for litigation brought by frequent litigators".

It is not a problem confined to the US. Patent trolls are setting up shop around

Nearly half of all US patent cases were filed in the Eastern District of Texas

the world. Christian Paul, a Munich-based partner at the law firm Jones Day, says that Germany is popular with trolls, "given the comparatively low cost of litigation and a tendency of courts to be rather patentee-friendly".

Meanwhile, in the UK, there are "some real disincentives for that sort of opportunistic behaviour", notes Prof Bessen. That comes down to two major reasons, he says. First, there are fewer software patents in the UK than in the US, and second, the loser-pays legal regime helps deter trolls from filing frivolous lawsuits.

Still, Europe should expect more patent troll litigation when the long-anticipated Unified Patent Court begins work in 2017. It will "likely increase patent troll litigation in Europe and, in particular, in the

Trolls: a patent risk

early phase once the UPC has become operational," says Mr Paul. "The main reason is that a judgment from the UPC will not be limited to the territory of one single country, but rather cover the territory of all participating member states," he adds. "This significantly increases the business risk when an injunction should be issued."

Add to that new procedural rules, multinational panels of judges from different jurisdictions and a lack of substantive case law, and patent trolls "could try to exploit the resulting inherent uncertainty to more readily obtain a settlement", he says.

The UPC's impact may well be felt globally, Mr Paul adds, as the court's remit will extend to any company that sells its products in the participating member states in Europe. US and Asian companies could find themselves defendants in the new system once it comes into effect.

Finding ways to end the practice is difficult. Mr Paul suggests adopting the UK loser-pays model and encouraging courts to deny injunctions to patent trolls, limiting their remedies to monetary damages only.

In the US, however, comprehensive patent reform bills in both the House and the Senate have stalled.

Some observers are hopeful that a narrower bill to limit where lawsuits can be filed may be pushed through this year.

According to Lex Machina, a company that provides legal analytics, 43.7 per cent of all US patent cases in 2015 were filed in the Eastern District of Texas, which is seen as particularly favourable to patent plaintiffs.

"[In the absence of] legislative reform, companies need to accept that patents are not a theoretical threat, but rather realistic business risks," Mr Paul says. "A diligent freedom-to-operate analysis and monitoring the patent register should be standard practice in today's markets."

