Innovation in smart connected objects accelerating fast worldwide with UK ranked sixth globally, patent data shows

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• EPO study reveals that technologies of the fourth industrial revolution (4IR) accounted for more than 10% of all patenting activity worldwide in 2018
• Global growth of 4IR patents nearly five times faster than average
• US is world leader; strong growth from China and South Korea; Europe losing ground
• Germany, UK and France are top three European countries
• UK 4IR inventions present in all sectors, with specialisation in AI and data security
• London among 20 most innovative regional clusters worldwide, but top 10 all located in Asia or US

Munich, 10 December 2020 – A study published today by the European Patent Office (EPO) shows that innovation in fourth industrial revolution (4IR) technologies has accelerated significantly worldwide. Between 2010 and 2018, global patent filings for these technologies, which concern smart connected objects and span the Internet of Things, big data, 5G, and artificial intelligence (AI), grew at an average annual rate of almost 20% – nearly five times faster than the average of all technology fields. The leading countries for 4IR innovation between 2000 and 2018 were the US, Japan, South Korea, China, Germany, the UK and France.

The study, entitled "Patents and the Fourth Industrial Revolution – the global technology trends enabling the data-driven economy", looks at all international patent families (IPFs) related to 4IR worldwide between 2000 and 2018. Each of these represents a high-value invention for which patent applications have been filed at two or more patent offices globally. The study finds that nearly 40 000 new IPFs were filed for these technologies in 2018 alone. This means they accounted for more than 10% of all patenting activity worldwide that year.

"Constellations of smart, connected devices, faster wireless internet, big data and AI are transforming the global economy and having a profound impact across many sectors, from manufacturing to healthcare to transport," said EPO President António Campinos. "What we are seeing is not just an acceleration of the development of information and communications technology – it is a major shift towards a fully data-driven economy. While Europe is not growing as fast as other regions, our strength lies in the diversity of our innovation ecosystem, the strong performance of some of our smaller countries with their high levels of specialisation, and some innovative regional clusters."

US in the lead, Europe and UK growing but losing ground

The study confirms that the US remains the world leader, accounting for around a third of all 4IR inventions filed between 2000 and 2018, compared with Europe and Japan with about one fifth each. Within Europe, Germany alone produced 29% of all 4IR patents generated by European companies and inventors between 2000 and 2018 – more than twice the contribution of the UK with 14.3% and followed by France with 12.5%. However, the average annual growth of 4IR innovation in these three countries since 2010 has been well below the world average (of 19.7%), with +15.4% for the UK, +14.9% for Germany, and +11.9% for France. By contrast, the fastest growing European countries in 4IR were Sweden (+22.6%) and Switzerland (+19.6%). The average annual growth rates since 2010 were +15.5% for Europe, +15.8% for Japan, and +18.5%

for the US.

Strong increase from China and South Korea

Starting from very low levels in the late 2000s, the innovative activity of China and South Korea has increased at a very high rate (posting annual average growth of 39.3% and 25.2% respectively from 2010 until 2018). This is also reflected in the ranking of the top 10 patent applicants in 4IR technologies between 2010 and 2018, which is headed by two South Korean companies Samsung and LG and also includes four US companies, two European firms and one from each of Japan and China. A comparison with the ranking for the previous decade shows that the top European and Japanese applicants have lost ground to their US, South Korean and Chinese counterparts since 2010.

UK 4IR innovation distributed across all technology sectors

Looking at technology specialisation profiles, the 4IR contribution of the UK appears evenly distributed across all three sectors of core technologies, enabling technologies and application domains, with some specialisation in enabling technologies, such as AI and data security. This distinguishes it from many other European countries, which are characterised by a relatively low level of patenting in core technologies and some specialisation in enabling technologies and application domains. The top three UK companies for 4IR patents in 2000-2018 are BAE Systems (with a focus on innovation related to user interfaces and IT hardware), Vodafone (focus on connectivity and consumer goods) and BT (connectivity and software). The UK is also an important 4IR innovation centre for foreign companies. Over 50% of 4IR inventions originating from the UK are owned by foreign companies such as Sony, Nokia or IBM.

London among top 20 regional 4IR innovation clusters

The patent data in the study also shows that innovation is concentrated in regional clusters of innovation around the world. The ranking is topped by 13 Asian and US clusters, followed by seven clusters located in Europe and the Middle East (see Figure: Top global 4IR clusters in Europe and the Middle East
(https://mediacentre.epo.org/razuna/assets/1/48E87A7B232941C28C61EBF14484744C/img/AA7457FCB4074A4897896FE9
All US, South Korean and Chinese clusters in the top 10 grew strongly between 2010 and 2018, with the region of Beijing achieving the highest increase in patent filings (+30% per year). By contrast, top clusters in Europe and Japan have experienced lower average annual growth in patenting during the same period. London, at number 16, accounted for 1.1% of global 4IR patent applications and posted average annual growth of 12.9% between 2010 and 2018.

Further information
Read the full study and executive summary at: epo.org/trends-4IR
(https://www.epo.org/service-support/publications.html?pubid=222#tab3)

Notes to the editor

• This study will be presented by the EPO’s Chief Economist on 17 December 2020 at a virtual conference entitled The role of patents in an AI driven world. (17/18 December 2020). Find out more and

register (free of charge) for this event (https://www.epo.org/news-events/events/conferences/ai2020.html).
• Read more about the Fourth Industrial Revolution (https://www.epo.org/news-events/in-focus/ict/fourth-industrial-revolution.html).
• For more statistics, visit the EPO's Patent Index 2019 (https://www.epo.org/about-us/annual-reports-statistics/statistics/2019.html).

About the study

This is the second study published by the EPO on patents and the fourth industrial revolution, following the publication of a report in December 2017 focussing on European patents. The current study takes a global perspective and is based on the concept of international patent families (IPFs). It looks at all IPFs filed by companies and inventors around the world from 2000 to 2018 across over 350 distinct technology fields. The study also pinpoints the major clusters for particular 4IR competences in the US, Europe, Japan, South Korea and China, and includes four case studies highlighting a range of inventions related to the fourth industrial revolution.

About international patent families

The patent analysis in this report is based on international patent families (IPFs). Each IPF represents a unique invention and includes patent applications filed and published in at least two countries or filed with and published by a regional patent office, as well as published international patent applications. IPFs represent inventions deemed important enough by the inventor to seek protection internationally, and only a relatively small percentage of applications meet this threshold. They can thus be used as a sound basis for comparing international innovation activities, as they reduce the biases that may arise when comparing patent applications across different national patent offices.

About the EPO

With 6 600 staff, the European Patent Office (EPO) is one of the largest public service institutions in Europe. Headquartered in Munich with offices in Berlin, Brussels, The Hague and Vienna, the EPO was founded with the aim of strengthening co-operation on patents in Europe. Through the EPO's centralised patent granting procedure, inventors are able to obtain high-quality patent protection in up to 44 countries, including the United Kingdom, covering a market of some 700 million people. The EPO is also the world's leading authority in patent information and patent searching.

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