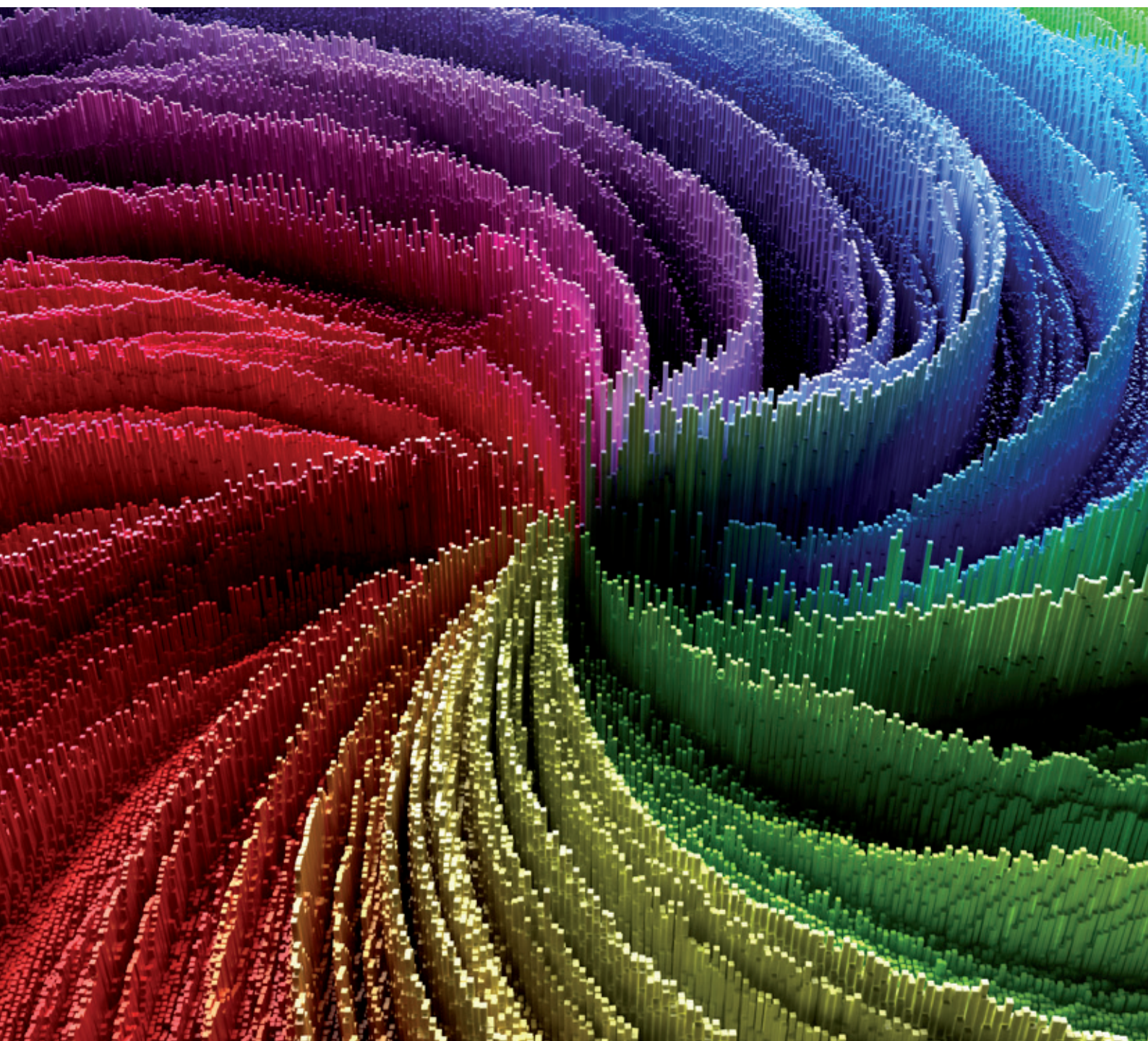




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Patents and additive manufacturing

Trends in 3D printing technologies
July 2020 | Executive summary



Executive summary

Aim of the study

Additive manufacturing (AM), more commonly known as 3D printing, is radically changing the way in which products are made. Manufactured objects have been produced for centuries using the same conventional processes, such as forging, casting and machining. AM offers a new approach, whereby thin layers of material are deposited one on top of another until a complete three-dimensional object is formed. This new approach is compatible with a large variety of materials, from metals to living cells, and has a wide range of potential industrial applications.

AM is primarily a digital technology, and as such one of the key drivers of the Fourth Industrial Revolution (EPO, 2017). 3D printed objects are the physical avatars of digital models that allow for highly sophisticated shapes or geometries. These models can be instantly diffused at virtually no cost, enabling the local fabrication of small volumes. They can also be modified, allowing in turn for the mass-customisation of 3D printed objects.

As the technology matures, it is estimated that AM could capture 5% or more of the global EUR 10.7 trillion (USD 12 trillion) manufacturing industry. While originally used for prototyping, its value is now seen in making industrial manufacturing more efficient, by using fewer resources while making it easier, cheaper and faster to build complex shapes and custom one-off designs. AM has the potential to redesign entire industry value chains, and will oblige companies to rethink their distribution models and to adapt to new forms of competition, while facing the challenge of creating appropriate legal frameworks to safeguard competition.

This study provides a comprehensive picture of current trends and emerging leaders in AM technologies. Drawing on the latest patent information from the European Patent Office (EPO), it gives a unique insight into AM innovation, and informs users of the patent system and policy-makers about AM's impact on industry.

About patent information

Patents are exclusive rights that are granted only for technologies that are new, inventive and industrially applicable. High-quality patents are assets for inventors because they can help attract investment, secure licensing deals and provide market exclusivity. Patents are not secret. In exchange for these exclusive rights, all patent applications are published, revealing the technical details of the inventions they describe.

Patent databases therefore contain the latest technical information, much of which cannot be found in any other source, and which anyone can use for their own research purposes. The EPO's free Espacenet database contains more than 120 million documents from over 100 countries, and comes with a machine translation tool in 32 languages.

This patent information provides early indications of technological developments that are bound to transform the economy. It reveals how innovation is driving the rise of additive manufacturing.

Key findings

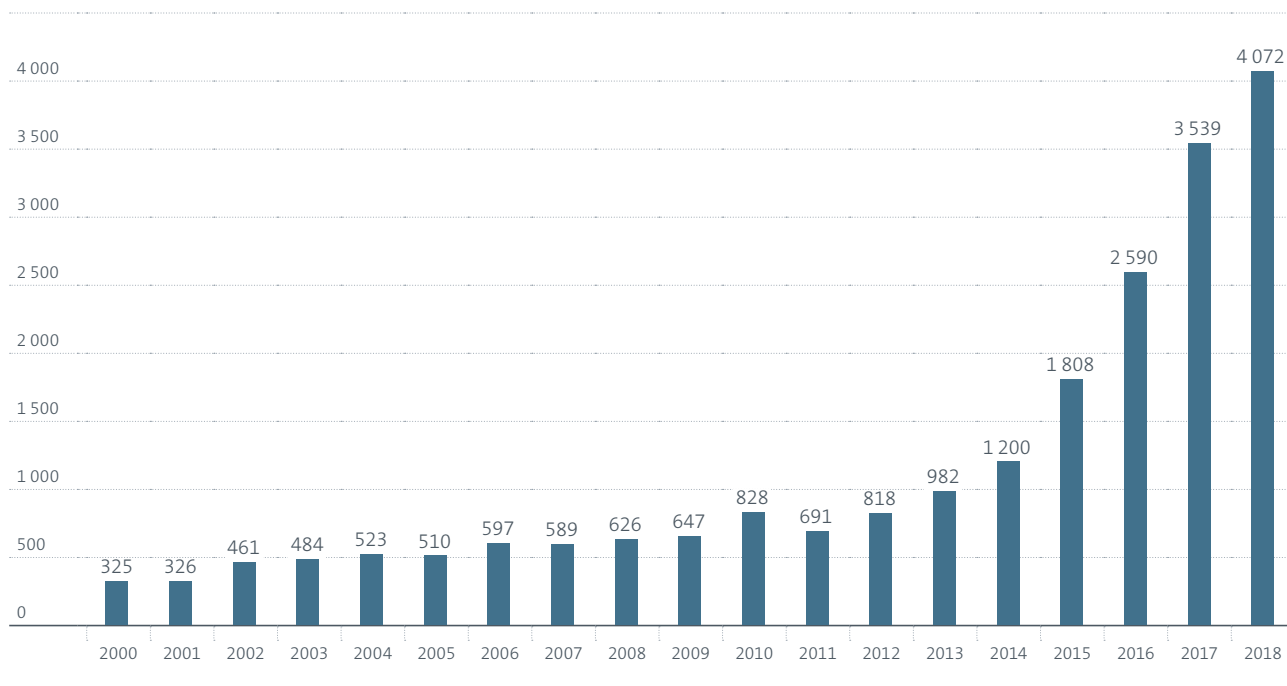
AM innovation is taking off

Innovation in AM has accelerated sharply in recent years, with more than 4 000 patent applications for inventions relating to AM filed at the EPO in 2018 alone. During the years 2015 to 2018, AM patent applications grew at an average

annual rate of 36%, which is more than ten times faster than the average yearly growth of patent applications at the EPO in the same period (3.5%). New industrial applications of AM technologies account for the largest share of patent applications in AM so far (50%). Other patent applications are related to machines and processes (38%), innovation in materials (26%), and digital technologies (11%). Almost 23% of AM patent applications relate to two or more of these different technology sectors.

Figure 1

Patent applications in AM technologies at the EPO, 2000-2018



Source: European Patent Office

Industrial applications of AM technologies span a large variety of industries. The use of AM in the medical and health sectors has generated the largest number of patent applications since 2010, followed by the energy

and transportation sectors. However, rapid growth of AM applications is also observed in areas such as industrial tooling, electronics, construction and consumer goods, and even in the food sector.

Figure 2

AM applications at the EPO by application domain, 2010-2018



Source: European Patent Office

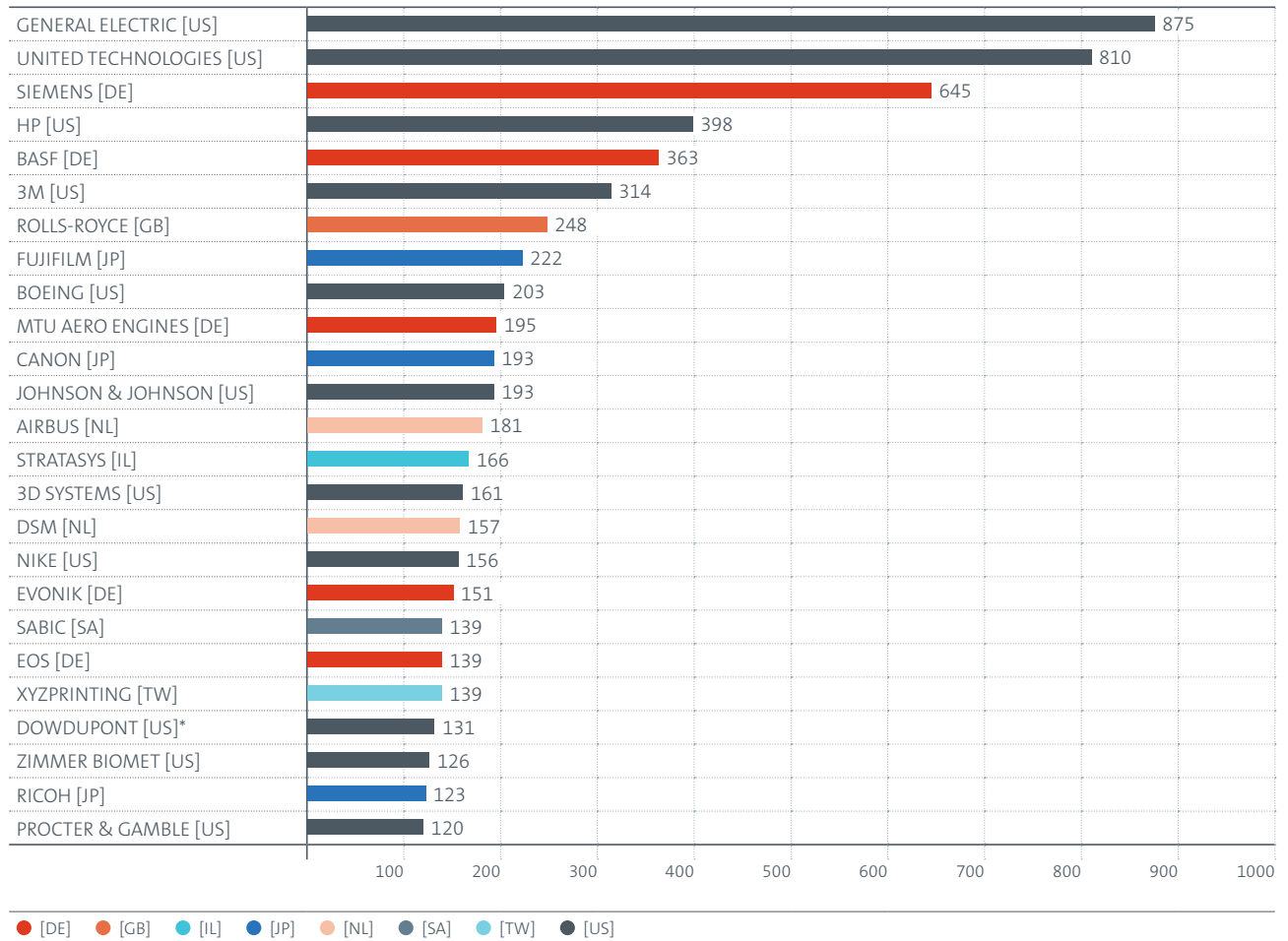
A highly diverse range of players

Twenty-five companies accounted for about 30% of all AM patent applications filed with the EPO between 2000 and 2018. They include large companies from a range of sectors, including transportation, chemicals and pharmaceuticals,

information technology, electronics, imaging and consumer goods, as well as pure 3D-printing specialists such as Stratasys, 3D Systems and EOS. The US and Europe dominate the ranking, with 11 US companies and eight European companies in the top 25 applicants. Of the top European applicants, five are German companies.

Figure 3

Top 25 AM applicants at the EPO, 2000-2018



Source: European Patent Office

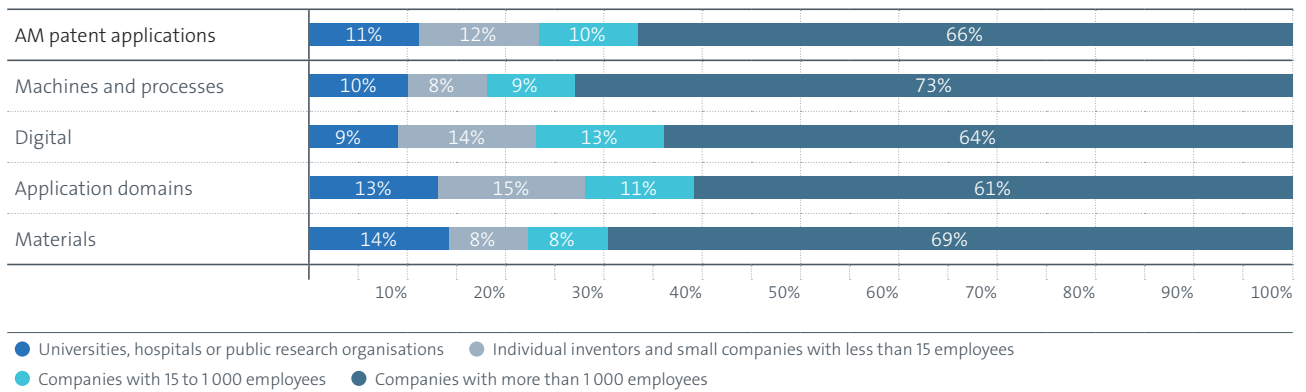
* DowDuPont was dissolved into three separate companies in 2019. For the purpose of this study the old company name is used.

While two out of three patent applications in AM technologies were filed by very large companies, companies with less than 1 000 employees accounted for 22% of applications. Individual inventors and small businesses with less than 15 employees generated 12% of patent applications in

AM. These small companies are especially active in digital technologies and new application domains. Universities, hospitals and public research organisations were responsible for over 11%, mainly concentrated in new materials and application domains for AM.

Figure 4

AM patent applications by applicant type and AM technology sector, 2000-2018



Source: European Patent Office

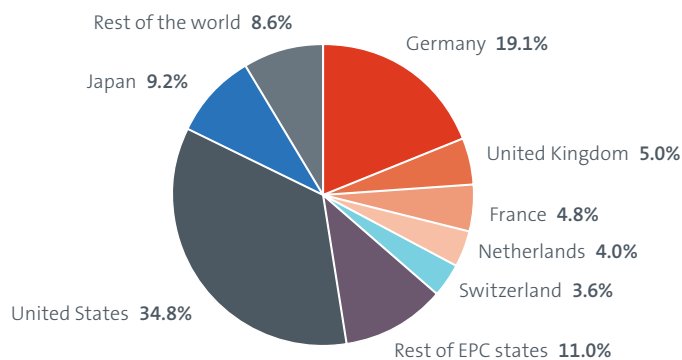
Europe and US at the forefront

Europe and the US have a strong lead in AM innovation, with 47% (Europe) and 35% (US) of all AM inventions for which a patent application was filed with the EPO since 2010. Europe's leading position is largely due to the performance

of Germany, which generated 19% of all patent applications in AM. Outside of Europe, Japan is an important innovation centre for AM technologies (9%), while R. Korea (1%) and P.R. China (<1%) made relatively modest contributions.

Figure 5

Geographic origins of AM applications, 2010-2018



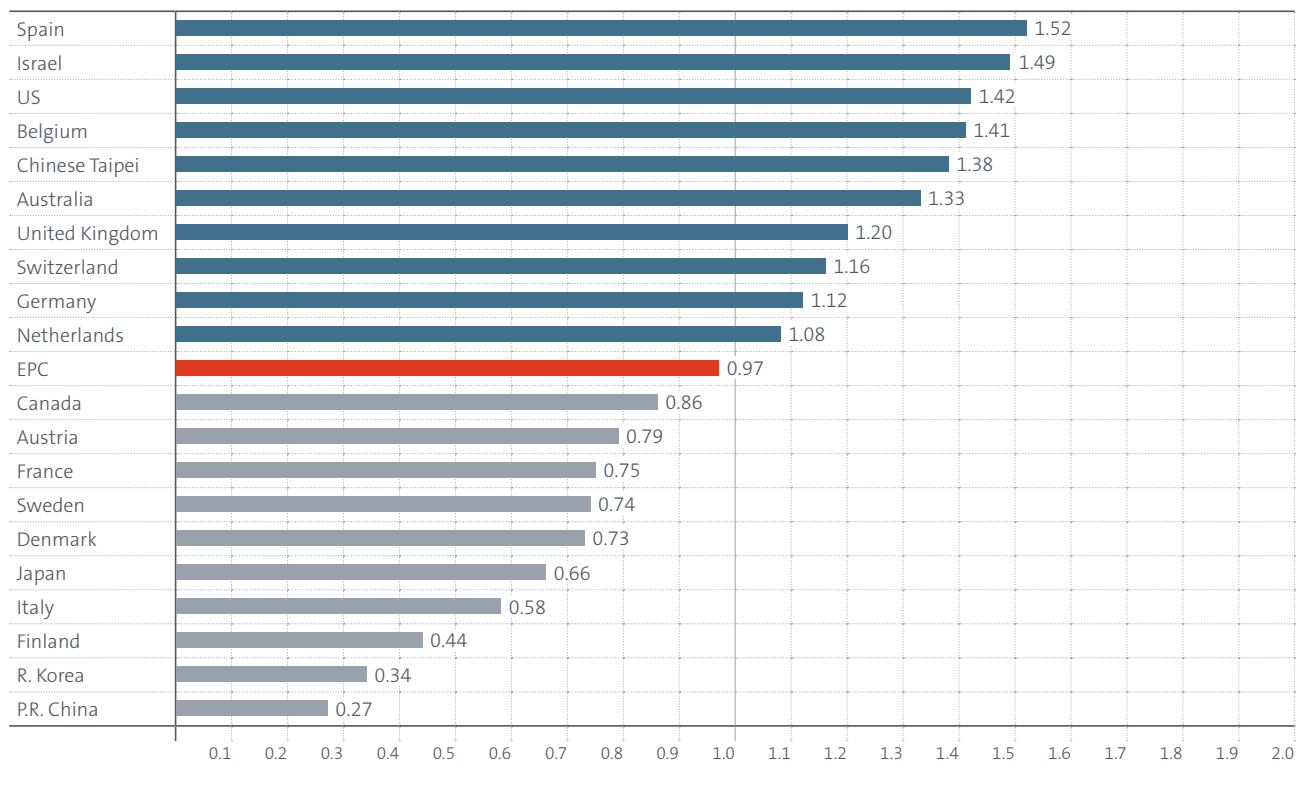
Source: European Patent Office

A revealed technological advantage (RTA) above 1 further indicates a pattern of country specialisation in AM patenting. At the global level, Israel, the United States, Chinese Taipei and Australia show a strong specialisation in AM innovation according to this indicator, whereas there is no

such specialisation in the case of the EPC area as a whole. A closer analysis of European countries however reveals a strong pattern of specialisation in AM patenting in some EPC member states. This is the case for Spain, Belgium, the United Kingdom, Switzerland, Germany and the Netherlands.

Figure 6

Revealed technological advantage (RTA) in AM technologies of the top 20 countries, 2010-2018



Source: European Patent Office

Note: Only countries with at least 100 patent applications in the period 2010-2018 have been considered.

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