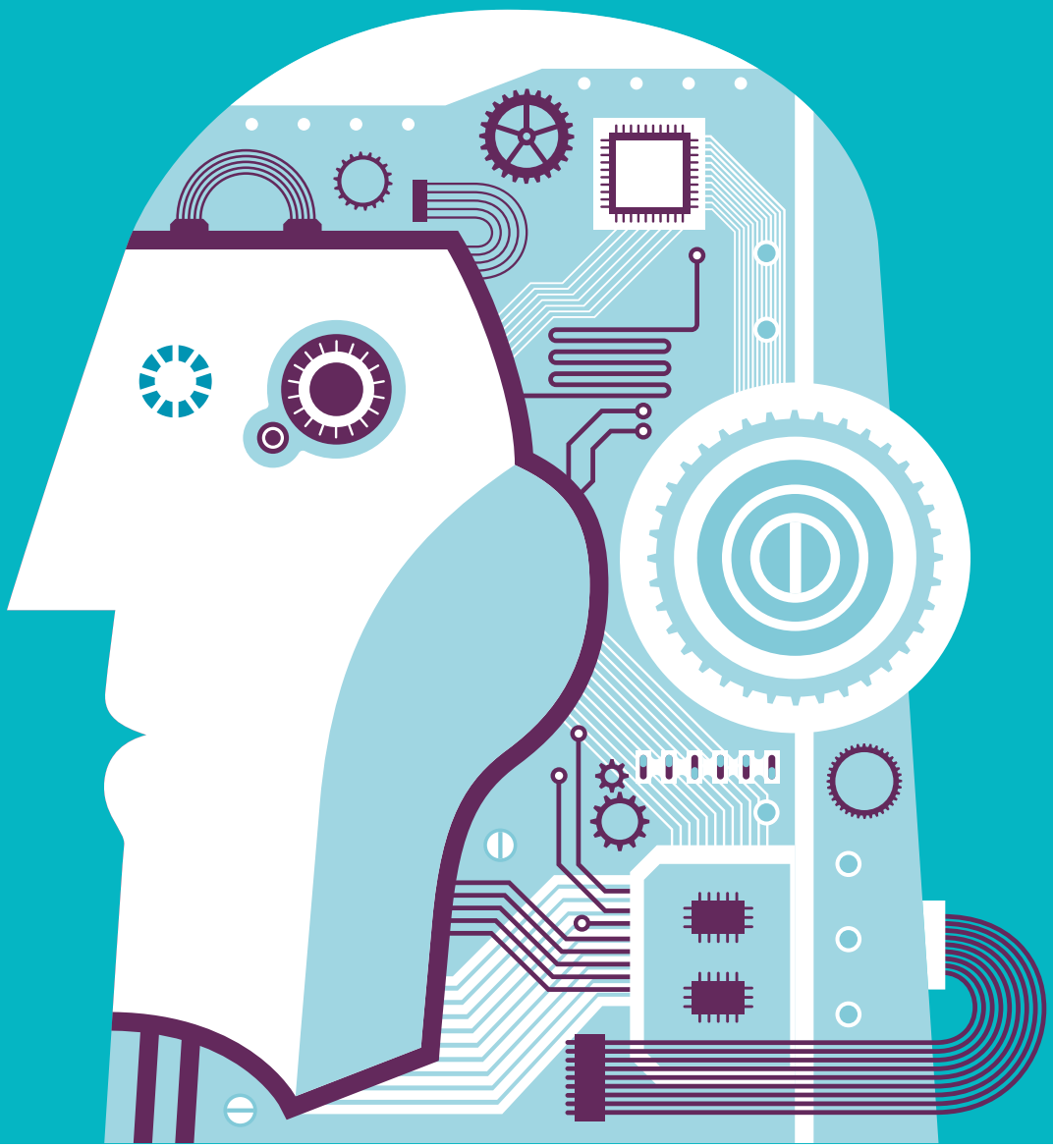
Rigorous empirical research on intellectual property



The examination of computer implemented inventions and artificial intelligence inventions at the European Patent Office

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European Patent Office

January 2019

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Europäisches Patentamt
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About the European Patent Office

With nearly 7 000 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, covering a market of around 700 million people. The EPO is also the world's leading authority in patent information and patent searching.

Suggested citation

Deltorn, J-M; Thean, A; Volkmer, M. The examination of computer implemented inventions and artificial intelligence inventions at the European Patent Office. (January 2019). 4iP Council.

The examination of computer implemented inventions and artificial intelligence inventions at the European Patent Office

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Executive summary

Computer-implemented inventions and applications of artificial intelligence have become an important part of the current innovation landscape. This trend is demonstrated by a significant increase in patents filings in a variety of technical areas, from self-driving vehicles to applications supporting the fourth industrial revolution.
The EPO, as the patent granting authority for the contracting states to the EPC, has developed, over time and in line with the case law of the Boards of Appeal, a stable practice regarding the patentability of computer-implemented inventions. This practice now also applies to applications in the field of artificial intelligence, where it offers a stable platform on which applicants and practitioners can secure patent protection for AI inventions at the EPO, with predictable outcomes.
The latest edition of the Guidelines for Examination, which entered in force on November 1st 2018, provides specific guidance about the patentability of artificial intelligence at the EPO.

Computer-implemented inventions as a driver of industrial innovation

The digital revolution has spawned a plethora of interconnected devices that generate and share digital data. Whereas the resulting torrents of information easily overwhelm humans, they are essential for training AI systems to generalise patterns, synthesise new connections and interpret new input. By the same token, as data repositories grow, AI systems become indispensable for organising and interrogating them. This has led to a new generation of artificial intelligence (AI) tools that are at the heart of an increasing number of products and services. Problems that were once intractable are being solved by a combination of machine learning, big data and computing power. Cars now drive themselves. Computers are beginning to recognise speech and classify images more accurately than their human creators, and robot scientists have begun to autonomously discover new drugs and new materials.[1] Software engineers have out-grown their cubicles, become bored of automating routine physical tasks, and are busy building networks of imaginative machines that will automate complex intellectual activities and transform society.

Access to big data, progress in machine learning and improvements in computing hardware are invigorating research and commercial interest in software. Developments in software production and services accounted for a large fraction of the total value added in the Information and Communications Technology (ICT) sector in recent years and patent filings at the European Patent Office (EPO) reflect the growing importance of Computer-Implemented Inventions (CII)[2] in fields beyond ICT.

CII are often prized assets with high economic and strategic value and where they are the result of innovative technical solutions they may be eligible for patent protection. The EPO, as patent granting authority for the contracting states to the European Patent Convention (EPC), has been proactive in developing predictable and consistent procedures for assessing the patentability of CII, including those related to AI. In this endeavour, it draws upon a growing body of CII-related case law, that has informed recent updates to its Guidelines for Examination. In 2016, the Guidelines were updated to include specific guidance for CII. The latest edition of the Guidelines, which entered in force on

[1] Nic Fleming "Computer-calculated compounds- Researchers are deploying artificial intelligence to discover drugs" Nature, 2018, Vol. 557, S55; Daniel P. Tabor et al. "Accelerating the discovery of materials for clean energy in the era of smart automation", Nature Reviews Materials, 2018, Vol. 3, p. 5.

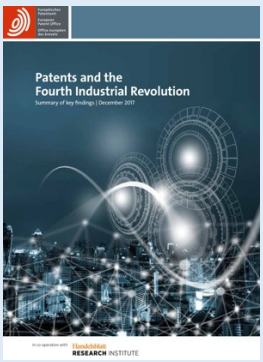
[2] A computer-implemented invention (CII) is one which involves the use of a computer, computer network or other programmable apparatus, where one or more features are realised wholly or partly by means of a computer program (See EPO Guidelines, G-II, 3.6).

November 1st 2018, provides further guidance about the patentability of mathematical methods, AI and computer-implemented simulation, design or modelling. Its online version includes a collection of hyperlinks for accessing sections relevant to CII.

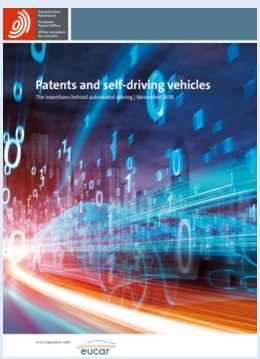
From the fourth industrial revolution to self-driving vehicles, the growth of computer-implemented and AI patent applications

The rising tide of computer-based applications is profoundly transforming the landscape of technology. The capacity of algorithms to optimise and automate increasingly complex tasks has led to a surge in productivity in some traditional industries and radical disruption in others. The result is new industrial activity and innovation on a scale that has direct and measurable impact on patent filings in Europe.

This trend has been described in a recently published comprehensive report carried out by the EPO in cooperation with European Council for Automotive R&D (EUCAR) in the field of self-driving vehicle (SDV) technologies.[3] The study showed that since 2011 the number of applications filed at the EPO in this burgeoning field grew by an unprecedented 330% (compared to 16% in all other areas of technology in the same period), with more than 4000 applications in 2017 alone. The report, details how inventions involving software represent up to 50% of patent applications in automotive technologies. Communication and Computing were the two fastest-growing SDV technologies, with total growth of 674% and 470% in the past 6 years. Computer-implemented inventions, including AI and machine learning, are key components of these fast-growing fields. In fact, the study observes that "*future mobility solutions and vehicles are set to take advantage of ever-growing computing power, high-speed connectivity, deep learning algorithms for artificial intelligence and fast and decentralised data handling. Through the rapid technological evolution in the telecom, IT and semiconductor industries, a completely new range of applications for smart and safe mobility appears increasingly possible*."[4]



The massive deployment of an Internet of Things (IoT) is about to precipitate a Fourth Industrial Revolution (4IR). These objects can operate autonomously based on the data they collect or exchange with each other. Once combined with other technologies, such as cloud computing and artificial intelligence, they enable the automation of entire business processes, including repetitive intellectual tasks previously performed by human beings. Autonomous objects are already transforming a large variety of sectors from manufacturing and agriculture to health and transportation. The deepest changes are yet to come. This study draws on the latest available patent information to analyse the innovation trends that signal the dawn of 4IR.
https://www.epo.org/service-support/publications.html?pubid=163

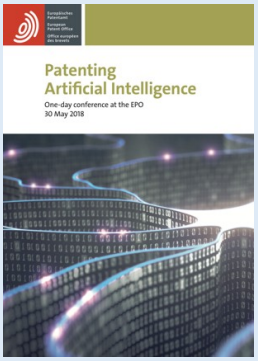


Self-driving vehicles (SDVs) are expected to be commercially available from 2025 and have the potential to create a transport revolution. Leading automotive companies are now deploying massive R&D capacities to develop new technologies in this field. This study provides a comprehensive picture of current trends and emerging leaders in SDV technologies. Drawing on the most recent patent information from the European Patent Office (EPO), including as yet unpublished patent applications, and incorporating advanced technology expertise in the field, it is a unique source of intelligence which will enable policy-makers and industry leaders to understand and anticipate the significant changes that are on the way.
https://www.epo.org/news-issues/news/2018/20181106.html

[3] EPO Study "Patents and self-driving vehicles - The inventions behind automated driving", November 2018.
[4] Id., at p. 18.

Another recent study carried out by the EPO in cooperation with the Handelsblatt Research Institute provided a detailed overview of current patenting trends in a variety of technologies related to the Fourth Industrial Revolution (4IR), including applications related to the Internet of Things, cloud computing and artificial intelligence.[5] In 2016 alone, more than 5 000 applications were filed at the EPO for inventions relating to autonomous objects, and 4IR applications of artificial intelligence ranked as one of the fastest-growing fields, with an average annual growth rate of 43% between 2011 and 2016 (compared to 7.65% in other fields).

Computer-implemented applications and artificial intelligence are therefore an essential component of today's innovation and patent landscape. In some technical fields, these applications already account for a large fraction of filings at the EPO. For example, it is estimated that approximately half of the patent applications received in the areas of automotive and medical technology include a CII component.[6] Faced with a growing number of applications focused on, or including, CII and AI features, the EPO has invested significant effort in communicating with a wide array of stakeholders. In May 2018, a first large-scale conference dedicated to "Patenting Artificial Intelligence" was held at EPO in Munich, while a second event took place in The Hague on the 4th of December 2018 on the theme of "Patenting Blockchain". These events allow the EPO to engage in an open and constructive dialogue with interested parties and provide them with an overview of its current practice in these emerging and fast-evolving technologies.[7]



The impact of Artificial Intelligence on our daily lives is intensively discussed in all areas of society and technology, around the globe. How relevant is patenting to the world of AI? This conference brought together experts from business, academia, the judiciary, policy making and patent offices in a series of lectures and panel discussions to discuss and explore the challenges that AI brings to patenting.

For more information:
https://www.epo.org/learning-events/events/conferences/2018/ai2018.html

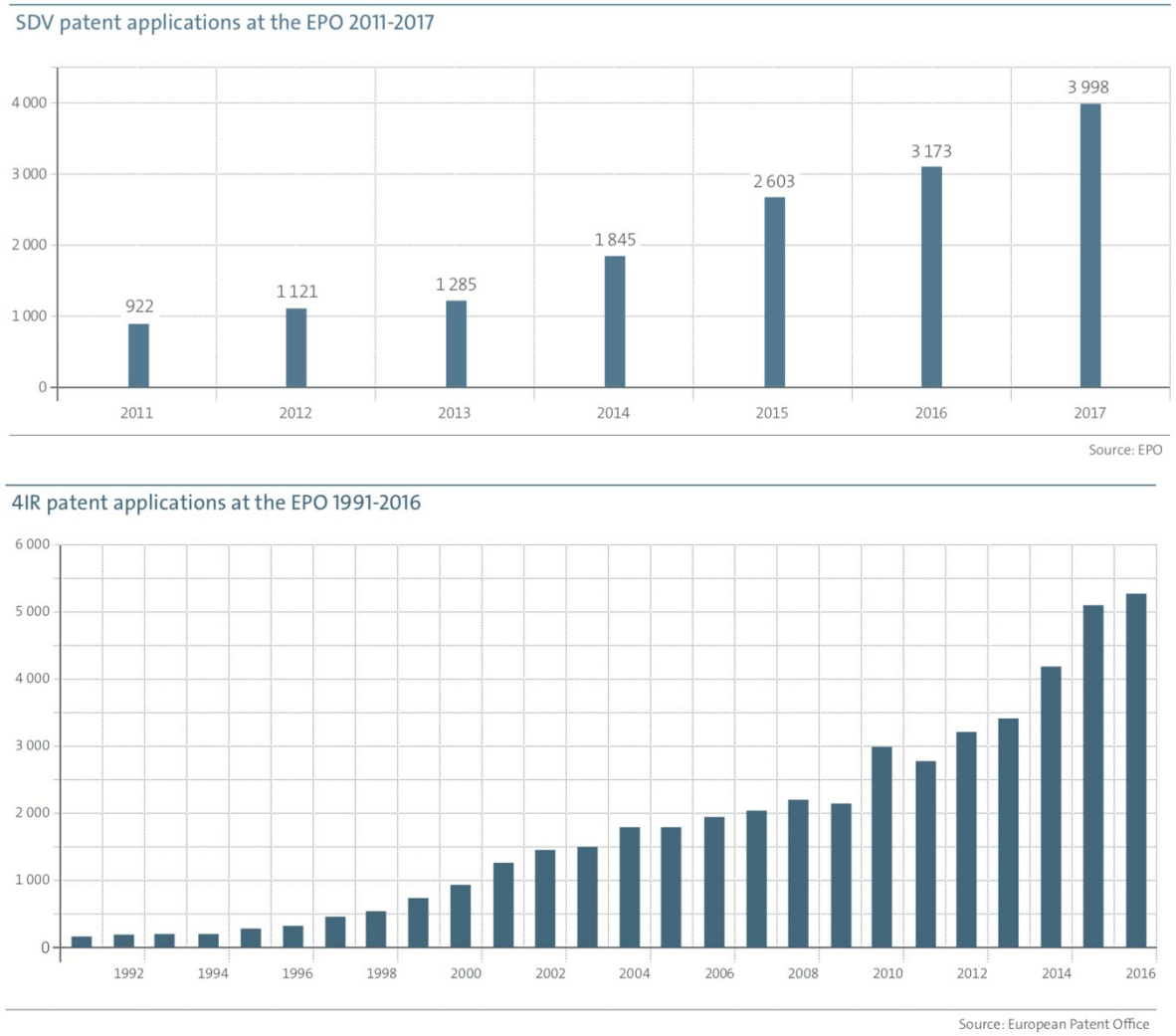
Blockchain technology is being applied to an ever-increasing variety of technical fields. Amongst the themes developed at the conference: the IP protection and in particular the patenting of blockchain technology and of its applications in different technical fields, but also the presentation of blockchain-related examination practice at the European Patent Office within the context of its well-established practices for patenting software / computer-implemented inventions.

For more information:
https://www.epo.org/learning-events/events/conferences/blockchain2018.html

[5] EPO Study "Patents and the Fourth Industrial Revolution: the inventions behind digital transformation" 2017.

[6] < https://www.epo.org/news-issues/news/2018/20180530.html >

[7] The proceedings, as well as video recordings, of the "Patenting Artificial Intelligence" conference are available online at : < https://www.epo.org/learning-events/events/conferences/2018/ai2018.html >. The proceedings of the "Patenting Blockchain" conference will also be made available on the EPO website after the event.



1 The growth in patent applications in technical fields related to the 4th industrial revolution (top) and in self-driving vehicles (bottom). CII and AI applications are amongst the fastest-growing fields in each of these technologies.

The patentability of computer-implemented and AI inventions at the EPO

The increase in patent filings related to CII and AI has prompted the EPO to address in earnest the criteria required to decide on their patentability. This practice builds on foundational work, started decades ago. As William Chandler, member of the Board of Appeal, observed in 2015, "*Over the last thirty years the boards of appeal of the European Patent Office have dealt with over one thousand cases that could be termed computer-implemented inventions or CIIs for short. In doing so, they have established a body of rather consistent jurisprudence*."[8] This accumulated experience is integrated in the Guidelines for examination at the EPO to ensure that applications are treated consistently by examiners in a way that is transparent to applicants. The Guidelines are regularly updated and take into account developments in case law.

GUIDELINES 11/2018
The Guidelines for Examination in the EPO give instructions on the practice and procedure to be

[8] William Chandler "Patentability of computer- implemented inventions (CIIs): state of play and developments" Official Journal EPO, Supplementary publication 5, 2015, p. 73.

followed in the various aspects of the examination of European applications and patents in accordance with the European Patent Convention and its Implementing Regulations. The Guidelines are updated at regular intervals to take account of developments in European patent law and practice as these continue to evolve.
The latest instance of the Guidelines for Examination in the EPO entered in force on November 1st 2018. The amendments to the 2018 Guidelines are identified in a dedicated page of the EPO website:
https://www.epo.org/law-practice/legal-texts/html/guidelines/e/m.htm

The latest version of the Guidelines includes an expanded section on "mathematical methods" (section G-II, 3.3) as well as an additional sub-section dedicated to "artificial intelligence and machine learning" (section G-II, 3.3.1). These sections provide further guidance as to the patentability of inventions related to the broad field of CII and AI.
The EPO website further includes an index of all sections of the Guidelines related to CIIs: https://www.epo.org/law-practice/legal-texts/html/guidelines/e/j.htm

How are patent applications related to CII and AI examined before the EPO? Like any other inventions, CIIs and AI inventions must meet the fundamental legal requirements of novelty, inventive step and industrial application in order to be patentable. The EPC does not define positively what an invention is, rather it provides a non-exhaustive list of "non-inventions" defining subject matter and activities that are excluded from patentability to the extent that they relate to such subject matter as such (Articles 52(2) and 52(3) EPC). The reference to an "invention" in conjunction with the other patentability criteria set out in Article 52(1) EPC makes it an independent condition to be met by all patent applications. In practice, to test whether the subject matter defined in the claims of a European patent application is considered a non-invention requires demonstrating the absence of any "technical character".

If the claims define purely abstract (e.g. mathematical) subject matter then they fall under the exclusion. For example, a claim only defining "a method of classification using machine learning" is considered abstract, i.e. non-technical, and would be excluded. Similarly, phrases such as "deep learning", "artificial neural network" and "support vector machine" are considered to define abstract entities that would fall under the exclusion of Article 52(2)(a) EPC, if claimed as such. However, if a claim defines technical means, it will not be considered to define excluded subject matter "as such". In order to be considered eligible, the claimed subject matter should therefore include at least one technical component. The mere reference to a physical system, for example a "method implemented on a computer" would give the claim a sufficient technical basis to pass the eligibility test. Similarly, reference in the claim to a specific physical signal renders the claim technical. This approach is often referred to as the "any hardware approach". Since computer-implemented inventions can pass the first patentability hurdle in Articles 52(2) and (3) EPC by merely embodying or making use of any form of technical means, overcoming this rather low eligibility hurdle should prove relatively easy. However, this is only the first hurdle that CII and AI inventions must overcome.

Once the eligibility hurdle is passed, like any other invention, computer-implemented inventions must meet the fundamental requirements of novelty, inventive step and industrial application. To assess novelty and inventive step in mixed-type inventions (consisting of a mix of technical and non-technical features), the EPO follows the practice established in the case law: "*where a feature cannot be considered as contributing to the solution of any technical problem by providing a technical effect it has no significance for the purpose of assessing inventive step*".[9] Conversely, the assessment of the inventive step of a mixed-type invention requires that "*all features which contribute to the technical character of the invention must be taken into account"*. Indeed, features that are, in isolation, non-technical, can contribute to the technical character of the claimed invention.[10] The question, then, is to

[9] T 0641/00 (at 6).

[10] For specific examples, see EPO Guidelines, G-VII, 5.4.2.

determine whether, and under which conditions, such a contribution arises. For a mathematical step to participate to the technical character of an invention, it must contribute "*to producing a technical effect that serves a technical purpose, by its application to a field of technology and/or by being adapted to a specific technical implementation*".[11] Indeed, if an algorithm is specifically adapted to the internal functioning of the computer (e.g. to the architecture of a computer, for example by taking advantage of different processing units (e.g. CPU and GPU) for successive phases of training a machine learning model), it may arguably be considered to provide a technical contribution to the invention.[12] A mathematical algorithm may also contribute to the technical character of a computer-implemented method if it serves a technical purpose.[13] A non-exhaustive list of examples for a variety of technical purposes which may be achieved by a mathematical method is provided in the Guidelines (section G-II, 3.3). Amongst them, the control of a specific technical system or process (e.g. an X-ray apparatus or a steel cooling process) is deemed technical. Similarly, applications in the fields of digital audio, image or video, such as encoding, compressing, or analysing are considered technical purposes. However, merely specifying the data used as an input is not in itself necessarily sufficient to ensure that the mathematical method contributes to the technical character of the invention. Rather, as noted in section G-II, 3.3 of the Guidelines, "*Whether a technical purpose is served by the mathematical method is primarily determined by the direct technical relevance of the results it provides*". In the same spirit, a generic purpose such as "controlling a technical system" is not sufficient: the technical purpose must be a specific one and the claim must be functionally limited to the technical purpose.

Since computational models and algorithms *per se* are considered abstract, the guidance provided in section G-II, 3.3 with respect to mathematical methods also applies to AI and machine learning: and an AI method step can only contribute to the technical character of the invention if it serves a technical purpose or if it is specifically adapted to the internal functioning of a computer. Section G-II, 3.3.1 provides some examples of technical applications of AI/ML. For instance, the identification of arrhythmic patterns based on using an artificial neural network in a cardiac monitoring apparatus is considered to make a technical contribution. Similarly, classifying audio, image, and video signals are further typical technical applications of AI/ML algorithms. However, not all applications of AI meet the requirement of technicality. In particular, the classification of text documents based only on their semantic content is considered, as such, a linguistic application, without technical contribution.[14] Furthermore, "*Classifying abstract data records or even "telecommunication network data records" without any indication of a technical use being made of the resulting classification is also not per se a technical purpose, even if the classification algorithm may be considered to have valuable mathematical properties such as robustness"*.[15] The deliberate choice to put forward a set of examples in the current version of the Guidelines, should help patent applicants give flesh to the notion of "technical character" and help circumscribe the notion of technicality in the context of CII as well as mathematical and AI/ML features.

Conclusion

Computer-implemented inventions and, recently, applications in the fields of artificial intelligence and machine learning have become an essential component of today's innovation landscape. Patents are one of the principal tools to promote and incentivise technical progress and reflect this trend. In fact, CII applications now account for a significant fraction of current filings at the EPO.

As the patent granting authority for the contracting states to the EPC, the EPO strives to update its practice in response to the latest technological developments. The recent update of the Guidelines for examination at the EPO presents the latest consolidation of our established practice regarding computer-implemented inventions and includes an expanded section on mathematical methods as well

[11] EPO Guidelines, G-II, 3.3.

[12] Cf. T 0258/03, OJ EPO 2004, 575 (at 5.8).

[13] See T 1784/06 (at 3.1.1). See also, T 1227/05, T 1358/09.

[14] See T 1358/09, T 0022/12.

[15] EPO Guidelines, G-II, 3.3.1.

as a new section dedicated to AI and machine learning. This adaptation effort is also manifested through an internal training program to ensure the consistent application of the CII content of the Guidelines. The constitution of mixed examining divisions is also an effective way to proceed with the examination of CII applications. The three-member examining divisions can be composed of examiners with different technical backgrounds, including CII/AI experts, if required.

The established practice developed over time and in line with the case law of the Boards of Appeal offers a stable platform on which applicants and practitioners can secure patent protection for AI inventions at the EPO, with predictable outcomes. This, however, is part of an ongoing effort that requires permanent reassessment. As technology evolves and new technical objects emerge, from CII to AI/ML or Blockchain-based applications, case law and patent examination procedures adapt to appraise these new creations in line with the European Patent Convention. As observed by Grant Philpott, Chief Operating Officer of the ICT sector at the EPO, in the concluding remarks of the EPO conference on "Patenting Artificial Intelligence": "*AI is clearly an area of rapid growth and immense opportunity for innovation. But the patent system will have to work very hard to ensure that it remains precisely that - an opportunity. Events such as this one help us to meet that challenge, ensuring that AI and its impact on patents and patentability is dealt with systematically and in unison with all stakeholders*."[16]

[16] EPO Patenting AI Conference, May 2018.