# PATENTABILITY OF COMPUTER-IMPLEMENTED SIMULATION METHODS − *CONNOR* AS AN EXAMPLE OF THE EUROPEAN PATENT LAW CREATION PROCESS

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Euroopan patenttiviraston (EPO) valituslautakunnille on annettu tehtäväksi tulkita Euroopan patenttisopimusta (EPC) teknologian kehityksen valossa. Tämän tutkielman tarkoituksena on arvioida, ovatko tietokoneella toteutetut simulointimenetelmät patentoitavissa EPC:n nojalla. Tutkielmassa analysoidaan EPO:n valituslautakuntien ratkaisukäytäntöä koskien tietokoneella toteutettuja keksintöjä, viimeisimpänä päätöstä T 0489/14 (CONNOR), ja sitä seurannutta, kirjoitushetkellä vireillä olevaa, lähetettä EPO:n laajennetussa valituslautakunnassa.

Oikeuskäytännön tarkastelu paljastaa, että valituslautakunnat ovat määritelleet tietokoneella toteutetun keksinnön teknisen luonteen olevan olennainen edellytys sen patentoitavuudelle. Samalla ne ovat kuitenkin hyväksyneet useita ristiriitaisia tulkintoja ja osoittaneet myös olevansa valmiita laajentamaan tietyntyyppisten keksintöjen patentoitavuutta. Ottaen huomioon simulaationmenetelmiä kasvava merkitys useille eri teollisuudenaloille ja teknologioille, Connor-tapauksen yhteydessä valituslautakunnan esittämä "suoraa yhteys fyysiseen todellisuuteen" edellytyksenä sille, että tietokoneella toteutetulla simulaatiomenetelmällä voidaan katsoa olevan tekninen vaikutus, herättää kysymyksen sen tekemän lähetteen luonteesta. Onko kyseessä aito epävarmuus simulaatiomenetelmien teknisestä luonteesta vai onko sen tarkoituksena pyrkimys rajoittaa simulaatiopohjaisten keksintöjen patentoitavuutta? Tämän selvittämiseksi tutkielma tarkastelee myös EPO:n roolia eurooppalaisen patenttipolitiikan luojana.

Tutkielma päätyy johtopäätökseen, että EPC:n teknologian käsitettä ei tulisi ymmärtää staattisena, vaan että sen tulisi kehittyä todellisten teknologisten kehitysaskelten rinnalla. Tämä puolestaan edellyttää, että valituslautakunnilla tulee olla mahdollisuus tulkita EPC:ta joustavasti. EPO:n institutionaalinen rakenne ja päätöksentekoprosessit luovat kuitenkin huomattavaa epävarmuutta tietokoneella toteutettujen simulaatiomenetelmien patentoitavuudesta. Joitakin oikeustieteellisessä kirjallisuudessa ehdotettuja kirjaavia toimenpiteitä, kuten osallistumismahdollisuuksien lisääminen muutoksenhakumenettelyjen ulkopuolella, käsitellään tutkielman lopussa.

Asiasanat: *Euroopan patenttivirasto, immateriaalioikeus, keksinnöllisyys, patenttioikeus, tietokoneella toteutettu keksintö, tietokoneella toteutettu simulaatiomenetelmä*

ABSTRACT

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At the European Patent Office (EPO), the Boards of Appeal have been tasked with interpreting the European Patent Convention (EPC) in accordance with technological developments. This work sets out to assess whether or not computer-implemented simulation methods are patentable under the EPC. To answer this question, delineation of relevant EPO Boards of Appeal case law pertaining to computer-implemented inventions (CII) leading up to decision T 0489/14 (CONNOR) and the following referral to the Enlarged Board of Appeal, pending at the time of writing, shall be analysed.

The Boards of Appeal have through a case-by-case approach established that the technical character of a CII is an essential requirement of its patentability. However, case law reveals that the Boards of Appeal have adopted multiple contradictory interpretations what constitutes it and also demonstrated willingness to expand the scope of patentability for certain types of inventions. Considering the increasing importance of simulation methods to various industries and technologies, the Board of Appeal in Connor positing a requirement for technical effect in the form of "direct link with physical reality" for simulation methods appears significant. Hence, this thesis also sets out to inquire whether the referral is a genuine inquiry as to the technicality of computer-implemented simulation methods, or whether it is a patent policy question in the sense that the Board of Appeal is deliberately looking into ways to narrow the scope of patentability of simulation-based inventions. In order to answer the question, the EPO's role in shaping European patent policies shall also be examined.

Ultimately, this thesis concludes that the notion of technology in the EPC should not be a static one but one that evolves alongside actual technological developments − necessitating a level of flexibility for the Boards of Appeal in interpreting the EPC. However, due to the institutional design and opacity of the decision-making processes, there is considerable uncertainty with regard to patentability of computer-implemented simulation methods. Some remedies suggested in legal literature, such as increasing participatory opportunities outside appeal proceedings, will be discussed.

Key words: *European Patent Office, computer-implemented invention, computer-implemented simulation method, intellectual property law, inventive step, patent law*

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# 1 INTRODUCTION

## 1.1. THE CASE AT HAND – PATENTABILITY OF COMPUTER-IMPLEMENTED SIMULATIONS

Patent laws generally tread the line between providing sufficient incentives for spurring innovation and avoiding the dangers of overprotection, awarding patent protection for certain types innovations while excluding others. The debate over the patentability of certain types of innovations − especially business methods and software patents − and whether they are innovations in the first place, has been ongoing for the past few decades.

The complex interplay between patent law and technological advancements is nothing new. At the European Patent Office (EPO), the Boards of Appeal have effectively been tasked with interpreting the European Patent Convention (EPC) in accordance with technological developments. As will be discussed in this work, this task has often resulted in an interesting dynamic between patent policy makers and the patent community at large, and discrepant views on the appropriate patentability criteria. A recent culmination of this phenomenon is the potentially highly important referral G 1/19 (Patentability of computer-implemented simulations), currently pending before the highest appeal body of the EPO, the Enlarged Board of Appeal (EBoA), concerning, as the name suggests, the patentability of computer-implemented simulations, or more precisely simulation methods. The case has the potential to illuminate the patentability of computer-implemented inventions (CIIs) in Europe, but it also poses the more general question of where should the line between patentable and non-patentable be drawn.

The story of the referral pending before the EBoA referral is, in brief, as follows: In 2003, European patent application no. 03793825.5 (title of the application: "Simulation of the movement of an autonomous entity through an environment")[2] was filed with the EPO. The application contained claims for a mathematical model and an algorithm, i.e. a computer-implemented simulation method, for simulating the movement of a pedestrian crowd through an environment and a method of designing

[2] See the European Patent Register entry for EP1546948 for all related documents, available at https://register.epo.org/application?number=EP03793825&lng=en&tab=doclist (last accessed 24.11.2020). Published as international application WO 2004/023347, available at https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2004023347 (last accessed 24.11.2020).

a building that could be used to, for example, analyse how a building structure performance in an emergency and aid in the positioning of entrances and exits.

This particular patent application may not attract much attention at the first glance. While the EPC explicitly excludes certain subject-matter from patent protection *as such*, including computer programs and mathematical methods, if there is a technological aspect to the patent claim − for example, if the claimed innovation controls an industrial process or processes data representing physical things − it may be eligible for patent protection under the EPC. Through continuously refining its patentability criteria on a case-by-case-basis, the EPO Boards of Appeal have established that the *technical character* of a CII is an essential requirement of its patentability. The claimed computer-implemented simulation method, as presented above, could be regarded a typical use case of a computer simulation as it comprises of a mathematical model of a building structure and a mathematical model of pedestrian movement: there would appear to be an *adequately defined technical purpose* required for the claimed innovation in this case to be patentable in light of EPO's previous case law.

Nevertheless, the patent application was rejected by the first instance Examining Division, leading to the filing of an appeal to the Technical Boards of Appeal (TBA) and, eventually, to the decision T 0489/14 (Pedestrian simulation/CONNOR) [3] rendered on 22 February 2019. Referring three questions to the EBoA in the form of the referral G 1/19, the TBA appears to be minded to disagree with the established EPO case law, and possibly willing upend the EPO position that has remained relatively consistent and predictable for the last decade and a half. [4] What has transpired in practice is that, for the first time in over a decade, the EBoA has been invited to express its views on the patentability of CIIs in general − notably, for the first time in over a decade, as the previous referral related to the issue G 3/08 (Programs for computers) [5] was deemed inadmissible − and more specifically to decide on whether computer-implemented simulation methods are patentable, either by itself or as part of a design process. The referral has been welcomed by some as an opportunity to further clarify patentability requirements of CIIs and computer-implemented

[3] T 0489/14 (Pedestrian simulation/CONNOR) of 22.2.2019.
[4] Shemtov (2017), at p. 184.
[5] G 3/08 (Programs for computers) of 12.5.2010.

simulations in particular, but also has the potential to disturb the somewhat accepted and established practices.

Although G 1/19 has now brought the spotlight to the patentability requirements of computer-implemented simulation methods, it also invites to examine at the sorts of things which can be simulated. What would the implications of the EBoA's decision be, considering that simulations play an important role in the development of new products and technologies in various industries and contribute to research in most scientific fields? Should special spotlight be brought onto simulations, especially considering their potential to underlie the solutions to many different problems and to spur innovation in Europe simultaneously in many different areas? The referral has brought about many worried voices expressing concern, as the referral essentially singles out simulation methods from other CIIs.

As will be discovered in this work, as simulation methods have become advanced and as they have an increasing number of applications and are embedded in a variety of important and emerging technologies, also the question of their patentability appears to have become more difficult to answer with certainty. For the longest time, the debate has not so much been about whether simulation methods are protected by patents in Europe, but what is the appropriate scope of protection for them. *Connor* seems to bring about a new twist to these developments, which is why I have chosen to examine the aims and goals of the European patent system through the lens of this particular case. What are the technologies we want the system to protect, what kinds of innovations we want it to encourage? Interestingly, Connor appears to highlight that the EPO regards the issue of the relationship between the patentability of computer-implemented simulation methods and the "real-world effect" such inventions may or may not have to be of significance. Some CIIs, such as computer-implemented simulations, landing somewhere between virtual worlds and theory, real world and physical objects, have, as they become more important and more widely used with increasing number of different applications, the potential to cause upheaval in the field of patent law, where the starting point of awarding patent protection continues to remain in the protection of physical real-world objects and processes.

Reduced to the simplest form, the referral could be read to be concerned mainly with to what extent computer-implemented simulation methods may be protected under the EPC. However, underlying the referral are the questions *why* and *why now* are computer-implemented simulations under the EBoA's consideration. How do things become patentable or, conversely, fall out of the realm of patentability at the EPO; is the EBoA's understanding of technology consistent with the technology industry or is it willing to mould it to fit the patent policy? Is this uncertainty a necessary feature of the patent system, ensuring its functionality, or does it create unjustifiable arbitrariness? Would the ubiquitous presence of simulations render the statutory exclusions of patentable subject-matter of the EPC meaningless? What are the implications of the EBoA's decision – could it change the patentability landscape for all CIIs in Europe as a whole?

## 1.2. RESEARCH QUESTIONS

The most interesting topics for research in patent law are often found in the field of new technologies and recent innovations − this is also the case with this work. Considering the importance of technologies and innovations that land squarely between theory and real world or exist entirely in the virtual, I feel that the related patent law issues are worth examining. While these questions are broad, the simulation method in Connor provides a starting point and a sufficiently narrow lens to examine them.

Considering the limited premise given for this work, the first research question of this work is simply *are computer-implemented simulation methods be patentable under the EPC and if so, under what conditions*. Since the premise of this work is based on the referral currently pending before the EBoA, the analysis is both forward- and backward-looking and the conclusions will compare the various directions the decision may take and their possible implications. In order to provide a sufficient understanding how the EPO's current approach has come to be, a retrospective look will be taken on relevant EPC provisions and EPO case law. To understand the implications the outcome of the referral may have on CIIs in general and simulation methods in particular, a forward-faced look will be taken at emerging simulation-related technologies that may have significant roles in various fields of industry and everyday life in the future.

I will claim that this analysis will reveal important factors that underlie this process and pertain to the legitimacy of the EBoA's eventual decisions and the jurisprudence of the Boards of Appeal in general. Namely, the EPO plays a significant role as a patent law maker − and policy maker − when it comes to new technologies in Europe and its motivations and understanding of technology is often at odds with industry actors, creating tension. The second research question is, then, *where does the EPO's current uncertainty how to decide the case of Connor stem from and what does the situation tell us about the EPO's approach to dealing with (disruptive) innovations?* To evaluate the possible answers to this question, the institutional design of the EPO, its role in interpreting and creating patentability standards the process through which its positions on the patentability of new technologies gain legitimacy must be discussed.

### 1.3. METHODOLOGY

In analysing the first question, this work employs primarily a traditional *doctrinal* approach. Doctrinal methodology focuses on identifying, analysing and synthesising the contents of the law and related case law. It is generally the standard approach to finding solutions to legal problems and it is employed in most, if not all, legal research.[6] In this work, doctrinal methodology is required to ascertain the EPO's approach to the patentability of CIIs and, more specifically, simulation methods and the related developments in the EPO case law.

Law is not, and never has been, an independent field of study, existing in a vacuum.[7] While the doctrinal method is most suited for gaining sufficient understanding of the content of the relevant regulations and case law, when the object of the study in in the field of patent law, it is important to also consider the ultimate goals of the patent system, namely incentivising innovation and contributing to diffusion of knowledge and know-how.[8] Considering these underlying motivations of the patent system, carrying out any legal research without on it without assessing its economic implications would likely be unsatisfactory. Although this work will not strictly speaking employ the methodology of economic analysis of law (also generally known as *law and economics*), it intends to incorporate some economic insights underlying the design of the European patent system and as such be, as Albert Sanchez-Graells has labelled it, *economically informed*.[9] Similarly, employing solely the doctrinal method would leave out the technological implications changes in the patent system

[6] Watkins and Burton (2017), at pp. 10-13.
[7] Watkins and Burton (2017), at p. 23.
[8] Moir (2013), at pp. 63-64; Burk & Lemley (2003), at p. 1576.
[9] Watkins and Burton (2017), at pp. 171-173, 192-193.

have. The emerging discipline of *law and technology*, a descriptive methodology, can be used to describe the two-way interaction between the types and state of technology and the types and status of the applicable legal framework, including the underlying context and purpose of the applicable norms.[10] While there is an ample amount of sources on software patents and CII patents in Europe, this is not the case for simulation methods specifically, the technology that the referral before the EBoA centers on. Because of this, the patent law issues related to CIIs and more specifically to simulation methods in the light of the recent development at EPO shall be examined simultaneously with the technical facts, conditions and recent developments related to simulations. As such, I attempt to take an approach that could be called *technologically informed*.

In this work, I will argue that the features of the European patent system and how the EPO operates play into the significance of the outcome of the referral G 1/19, an imbalance recognised by a number of legal scholars.[11] While the tension between law and emerging technologies appears to be well-recognised, I initially experienced difficulties in finding a suitable framework through which to examine Connor and the EPO's role in in creating patent law through case law. Some sources cited in this work in support of this argument derive from the field of sociology, like Thambisetty's "technolaw" and "textualisation", originating from Bruno Latour's *Science in Action: How to Follow Scientists and Engineers Through Society*. Latour uses technoscience as an intermediary between technology and science, denoting the intensity of connection between the two. For Latour, scientific articles act as the rhetorical vehicle through which researchers communicate their claims to other researches to further develop and potentially criticise. Similarly, Thambisetty uses technolaw as an intermediary between technical and legal standards of patentability, denoting their intertwined nature. In the EPO context, Thambisetty considers the EPO's Examination Guidelines as the comparable rhetorical vehicle that allows for the EPC's technolaw to become operational and bestows legitimacy to the EPO jurisprudence.[12]

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[10] See Koops (2013) for a general introduction on the topic.
[11] See e.g. Schneider (2009), at p. 619 and Plomer (2019), at p. 58.
[12] Thambisetty (2017), at pp. 19-24, 44-56.

## 1.4. STRUCTURE AND DELIMITATIONS

The substance of this work will be discussed in six main chapters. Chapter 2 sets out to provide an overview of the European patent landscape and to examine how the EPC and the practices of the EPO are designed to accommodate new technologies. I will also locate simulation methods in the European patent law field. For expositional clarity and to provide a background for later arguments, Chapter 3 consists of a retrospective of how the EPO's stance on the technical character requirement and on the patentability of CIIs and the real-world effect have evolved, leading up to the current state of affairs and TBA's decision to refer Connor to the EBoA. Chapter 4 provides a detailed analysis of the questions referred to the EBoA and the potential outcomes of the EBoA's eventual decision. Chapter 5 explores how the referral relates in a more general manner to a number of central questions pertaining to European patent policy and the EPO's major role as an influential decision maker on the patentability of new technologies. In Chapter 6 the implications of the potential outcomes of the EBoA's decision on these fields of technology and, at a larger scale, the European innovation landscape when it comes to computer-implemented simulation methods, shall be discussed. Chapter 7 summarises the findings and makes suggestions for ways forward.

Considering the length of this work, some limitations are necessary. As this work centres around the referral G 1/19 before the EBoA, its focus will, naturally, be on the European patent system, i.e. the law, jurisprudence, and other guidance such as the Examination Guidelines relating to the EPC and the EPO. Notions of other patent systems, such as that of the United States or national European patent systems, will be limited to the impact the EBoA's eventual decision could have outside the EPC. This is strictly to provide a necessary limitation to the scope of this work and not in reflection to the significance or interconnectedness of different patent systems.[13] In addition, considering the fact that the research questions of this work require the examination of the technical character requirement and the large amount of case law pertaining to it, for the sake of brevity, I have attempted to identify the most relevant

[13] Many sources cited in this work, however, do this, see e.g. Shemtov (2017), comparing European and U.S. patent systems and jurisprudence. The importance of the law and practice of other jurisdictions is noted in some of the amicus curiae briefs submitted for G 1/19, see e.g. the brief submitted by the International Association for the Protection of Intellectual Property (AIPPI), dated 1.9.2020, summarising the current situation with regard to the patentability of CIIs in the U.S., Japan, China, Germany, the UK and Canada.

cases for the purposes of analysing the developments. This work does not aim to cover issues related to, for example, claim construction and patent infringement, or visit the topic of copyright versus patent protection for CIIs.

### 1.5. SOURCES

Due to the relative novelty of the referral and the fact that it has not yet been decided by the EBoA, apart from few short mentionings, Connor has not yet been discussed extensively in legal literature. However, while the TBA succinctly limited its observation that the outcome of the referral could affect the patentability of a number of emerging simulation-based technologies, such as artificial intelligence and virtual/augmented reality, to a brief statement that the EBoA's answers are important "for a potentially large number of cases involving computer-implemented simulations"[14], the significance of the case's outcome and its clear linkages to a large number of innovations have not gone unnoticed by the patent community at large. This is reflected by the number of amicus curiae briefs submitted by a wide variety of stakeholders, ranging from industry actors, organisations to individual patent law experts, the most salient points of which will be discussed in this work. Moreover, Connor has made it to the headlines of many commentaries and case summaries published by patent law practitioners over the internet. Connor also functioned (and at the time of writing, continues to function) as an interesting real-time case study: as the case is currently pending before the EBoA, I had the opportunity to follow the oral proceeding of the referral, live streamed via the EPO website in July 2020. My notes based on the discussions held during the proceedings constitute a significant source material for this work.

There is an abundance of legal material available discussing the patentability computer programs, CIIs, software, and software-related inventions under the EPC. In the process of writing this work, it appears that these works consider approach the topic from the perspective of the exclusion of computer programs as such from patentability. However, as will be discussed in this work, when it comes to computer-implemented simulation methods, the exclusion of computer programs as such must be looked at together with other subject-matter excluded "as such", namely discoveries, scientific theories and mathematical methods, methods for performing mental acts and

[14] T 0489/14 (Connor), r. 19.

presentations of information. In this regard, too, the discussions during the oral proceeding before the EBoA proved an important source.

For the analysis on the EPO's role as a patent policy and law maker, I have reflected Connor against the works of Burk and Lemley, Moir, Plomer, Schneider and Thambisetty in particular, who all contribute to bridging the gap in the existing legal discussion from different point of view.

# 2 THE EUROPEAN PATENT SYSTEM AND NEW TECHNOLOGIES

## 2.1 THE PROBLEM WITH PATENTS AND NEW TECHNOLOGIES

Patent, in essence, is an economic right and exception to the general rule of free competition that grants the rightsholder a temporary legal monopoly, generally for a period of twenty years, over the patented invention, excluding others from exploiting the invention for commercial gain.[15] Among the forms of intellectual property protections available, patents as exclusive rights are generally viewed as a strong form of intellectual property protection, as opposed to for example copyrights and trade secrets. While a patent provides an economic reward for past inventive contributions, a well-functioning patent system as whole serves a complex function, whereby it is expected to, among other things, incentivise future innovation that would not necessarily otherwise occur and to benefit the society as a whole, for example by promoting economic growth.[16] It is also posited that society benefits from the disclosure of the technical details of inventions and the subsequent diffusion of information as opposed to such information remaining a commercial secret.[17]

To achieve these aims, the setting of thresholds and standards for patent protection involves the balancing of legal standards and policy considerations. What kind of innovation merits the title of innovation and reaches the thresholds set out, for example, in the EPC, namely the requirements of novelty, inventive step and industrial application, in a manner that the granting of a twenty-year monopoly over it to the inventor is justified?[18] Technical considerations cannot be forgotten, either. Patent

[15] Christie (2011), at p. 121.
[16] Moir (2013), at pp. 63-64.
[17] Takenaka (2009), at pp. 68, 71; Plomer (2019), at p. 59.
[18] Plomer (2019), at p. 73.

applicants formulate the technical features of inventions they are seeking to patent in the so-called claims of a patent application, which ultimately, define the scope of protection granted by the patent and form the basis for any subsequent litigation regarding the granted patent. Claims for CIIs are primarily either apparatus claims, formulated in terms of the features of the device, or method claims, formulated in terms of the method steps.[19]

One important aspect legislators and policymakers must take into account in this balancing act is the trajectory of technological advancement. Firstly, innovations are made in fields of science, technology and engineering that range from completely new, with ample room for many ground-breaking innovations that could potentially define the entire field and render previously made innovations completely obsolete, to well-established ones, where most innovations tend to build on earlier innovation, bringing about relatively small improvements and refinements to existing technology.[20] Accordingly, based on the degree a given innovation constitutes a breakthrough compared to the existing state of technology, it can be considered to be either a radical or an incremental innovation, the former ones often being labelled as "disruptive" technologies. The relationship between these two types of innovation is often cyclical: radical innovation is often the result of accumulation of incremental improvements to a given technology or the integration of different existing technologies and, as these innovations mature, they tend to be further improved on in an incremental manner.[21]

Emerging disruptive technologies such as virtual reality, artificial intelligence and Internet of Things have been in the limelight in the recent years. Emerging technologies often create significant legal uncertainty: new laws may be needed to regulate new technologies, or clarification may be needed as to how existing laws should be applied to them. Simultaneously, legislators may experience difficulties in keeping up with rapidly and unpredictably developing technologies on the one hand and on the other, if new regulations are introduced unnecessarily or prematurely, they might hamper further desired developments.[22] Moreover, innovation is usually

[19] Skulikaris (2013), at p. 2.
[20] Shi (2005), at p. 331.
[21] Lohse (2018), at pp. 7-12, presenting several examples of radical innovation, such as cloud computing, the Internet of Things, 3D printing and autonomous vehicles, and noting that the benefits of incremental innovation often relate to improved cost-efficiency or functional improvements, such as improvements in user friendliness, reliability and capacity, and marginal additions to applications.
[22] Palmerini (2013), at p. 14.

difficult to measure, as technological advances may range from minute tweaks to well-established processes to previously unthinkable inventions, creating a threshold issue.[23]

## 2.2 THE EUROPEAN PATENT SYSTEM

In Europe, in addition to national patent offices of their choosing, applicants may file an application for a European Patent at the EPO. As stated in the preamble of the EPC, the organisation was created to "strengthen co-operation between the States of Europe in respect of protection of inventions".[24] More recently, in 2010, the EPO launched the "Raising the bar" -initiative, which emphasises "quality over quantity" to ensure that "the EPO grants patents only for innovations having sufficient inventive merit and meeting the needs of society".[25] The EPO, distinct from EU institutions, was established under an intergovernmental treaty, the EPC, in 1973. To achieve these aims, the EPC provides a harmonised framework and procedure for granting European Patents before the EPO, and with all European Union (EU) member states and several non-EU European states as contracting parties to it, it effectively creates a pan-European law governing the grant of patents.[26] The general aim of the EPC is to provide a simplified, reliable and less expensive patent application system. To achieve this, the signatory states to the EPC amend and model their national patent legislation in accordance with the Convention, especially with regard to the substantive requirement of patentability and patent validity. The EPC, however, does not mandate full harmonisation of national patent laws, and national rules and their interpretation continue to differ. Issues of validity and patent eligibility are currently decided on two levels, at the EPO level in relation to European patents and at national level in relation to national patents. Despite the focus being on a shared system for granting patents, the laws of member states to a large degree conform to the EPC's substantive patentability requirements and the standards developed by the EPO and it can be

[23] Ohlhausen (2016), at p. 16.
[24] Preamble, EPC.
[25] EPO, Annual Report 2008, at p. 8.
[26] Plomer (2019), at p. 64. Plomer further discusses how the EPO's organisational set-up and mandate, as set out in the preamble of the EPC, from the outset imply that the EPO is a functional, a-political organisation, unlike other inter-governmental international organisations.

argued that the EPC and the EPO determine, or at least heavily influence, national patentability requirements.[27]

Organisationally, the EPO is the executive branch of the intergovernmental European Patent Organisation (EPOrg), originally intended to have a mostly administrative role.[28] The second, formally legislative, branch of the EPOrg is the Administrative Council, which consists of the presidents of the national EPO-member patent offices. Amendments to the EPC, however, require a decision to be made in a Diplomatic Conference of the Contracting States.[29] In practice, substantive changes to patent law in new technical areas are not made by the Administrative Council or the Diplomatic Conference. Instead, they are accommodated through continuous reinterpretation of existing patent law by the EPO, partially tackling the problem of fast-moving technological developments and lengthy law-making. As will be discussed next, the fact that technology has the potential to advance to new and unforeseen directions heedless of the applicable legal standards is a notion built into the EPC: patent protection is available for *any inventions, in all fields of technology*, the language of the Convention being left technology-neutral on purpose.[30]

The EPO is comprised of several divisions and it has its own internal appeal procedure. At first instance, patent applications are handled by an Examining Division and should it refuse to grant a European patent, the applicant has the possibility to appeal and challenge the decision before a Board of Appeal, usually one of the 28 Technical Boards of Appeal (TBA). The decisions of the Board of Appeal are final, but as an exceptional measure, as set out in Article 112a EPC, it is possible for a party to an appeal to challenge the decision of a Board of Appeal before the EBoA on the grounds that intolerable procedural deficiencies occurred during the appeal proceedings or that a criminal act had impacted the decision. This appeal measure is not intended to result in the revision of substantive patent law, and the decision of the Boards of Appeal cannot be subject to any further legal action. However, in case a patent is maintained or granted by a Board of Appeal, its decision does not prevent actions aiming to revoke the patent before the competent national authorities in an EPO member state where the

[27] Shemtov (2017), at p. 178.
[28] Plomer (2019), at pp. 63-64.
[29] Schneider (2009), at p. 622.
[30] Burk & Lemley (2003), at pp. 1576-1577.

patent has effect.[31] In addition, according to Article 112(1) EPC, following a request from a party to the appeal, a Board of Appeal may request the EBoA to make a decision or to give an opinion on the relevant issue to ensure the uniform application of law if it considered that a decision is required in order to ensure uniform application of the law, or if an important point of law arises.[32] Moreover, the EPO President may refer a point of law to the EBoA where two Boards of Appeal have given different decisions on that question.[33]

As the decision to refer a case to the EBoA on the basis of Article 112(1) EPC ultimately lies with the Boards of Appeal and the EPO President, the referral possibility should not be considered to create an additional third layer of jurisdiction after the Boards of Appeal.[34] The EBoA has corroborated this interpretation of Article 112(1) EPC by stating the Boards of Appeal have, as the independent judiciaries of the EPOrg, the primary responsibility for interpreting the EPC.[35] Moreover, a decision deviating from an opinion given in another decision of a Board of Appeal, a diverging opinion expressed in a decisions by a different Board of Appeal, or a deviation from some national jurisprudence are not per se valid reasons for referral.[36] The EBoA may reformulate the questions referred to it as it seems fit and it is not obligated to construe them narrowly, but in a way that allows it to clarify the points of law behind the questions.[37]

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[31] Takenaka (2009), at pp. 224-225. Article 138 EPC lists the grounds upon which a European patent may be revoked by national authorities.
[32] Article 112(1)(a) EPC.
[33] Article 112(1)(b) EPC.
[34] Case Law of the Boards of Appeal, 9th edition, July 2019, V-B, 2.3.1. See e.g. Pila (2011), at pp. 214-216.
[35] See e.g. G 3/08. In discussing the admissibility of the questions referred to by the EPO President and the interpretation of Article 112(1)(b) EPC, the EBoA noted that the EPOrg's operations are based on the principle of separation of powers. To be more precise, the EBoA noted that the executive power to grant patents is assigned to the EPO, the management of organisational aspects of the EPO is assigned to the EPO President, limited legislative powers with regard to lower-ranking rules as well as financial and supervisory powers are assigned to the Administrative Council restricted, and the role of an independent judiciary is assigned to the Boards of Appeal, even if they are not an independent organ of the organisation (r. 7.2.1). Further, the EBoA noted that this separation of powers supports the Boards of Appeal having "interpretative supremacy" with regard to the EPC as their decisions are subject to review only under the narrowly defined conditions of Article 112(1) EPC (r. 7.5.2).
[36] Case Law of the Boards of Appeal, 9th edition, July 2019, V-B, 2.3.6., referring to the decision T 0154/04 (Estimating sales activity/DUNS LICENSING ASSOCIATES) of 15.11.2006. In T 0154/04, the TBA went further in stating that *"the legal system of the [EPC] gives room for evolution of the jurisprudence (which is thus not 'case law' in the strict Anglo-Saxon meaning of the term) and leaves it to the discretion of the boards whether to give reasons in any decision deviating from other decisions or to refer a point of law to the [EBoA]"* (r. 2).
[37] Case Law of the Boards of Appeal, 9th edition, July 2019, V-B, 2.3.1.

The EBoA does not, strictly speaking, follow the doctrine of precedent. The EBoA is not bound by previous EBoA decisions and, as a result, individual EBoA decisions may present diverging interpretations of the EPC.[38] As for the effect a decision by the EBoA has on the Boards of Appeal, according to Article 112(3) EPC, decisions of the EBoA shall be binding on the referring Board of Appeal only in respect of the appeal in question. However, a slightly contradictory instruction is provided by Article 21 of the Rules of Procedure of the Boards of Appeal: In case a Board of Appeal considers it necessary to deviate from an interpretation or explanation of the EPC contained in an earlier opinion or decision of the EBoA, it shall refer the question to it. This means, in practice, that a Board of Appeal cannot diverge from an EBoA decision entirely on its own accord.[39] Conversely¸ this also provides a Board of Appeal with an opportunity to challenge an earlier interpretation or opinion of the EBoA if it is minded to do so.[40]

In addition to the Convention, the decisions of the divisions and the Boards of Appeal are guided by the Examination Guidelines, produced by the EPO under the auspices of Article 10(2)(a) EPC, which prescribes the EPO President the power "to take all necessary steps to ensure the functioning of the [EPO], including the adoption of internal administrative instructions and information to the public".[41] Although the Examination Guidelines do not have the binding authority of a legal text, failure to do so only being a procedural violation if it constitutes a violation of a rule or a principle of procedure governed by the EPC or the Implementing Regulations[42], they provide a highly authoritative guiding document to the Examining Division, prescribing that the patent applicants and other parties may expect the EPO to follow the Examination Guidelines until the Examination Guidelines or the provisions of the EPC they refer to are amended.[43] Moreover, although not formulated by the Boards of Appeal nor

[38] Moir (2013), at p. 45.
[39] Smyth, Darren (2014, Jul 15).
[40] Thambisetty (2017), at p.8, see footnote no. 17.
[41] Thambisetty (2017), at pp. 6-7.
[42] Case Law of the Boards of Appeal, III-W, 2.
[43] Examination Guidelines, General part, section 3 (General remarks). Compare the 2019 version with the earlier version of the Examination Guidelines from June 2012, which permitted Examining Division departing from the Examination Guidelines in "exceptional cases". See para 3.2.: *"The Guidelines are intended to cover normal occurrences. They should therefore be considered only as general instructions. The application of the Guidelines to individual European patent applications or patents is the responsibility of the examining staff and they may depart from these instructions in exceptional cases."* For relevant case law, see e.g. decisions T 162/82 (Classifying areas) of 20.6.1987 and T 0042/84 (Alumina Spinel) of 23.3.1987 (as reported by Thambisetty (2017), at p. 9, see footnote no. 24). More recently confirmed in decision T 1607/08 () of 13.6.2012 ("Method for arranging compressed video data for transmission over a noisy communication channel"), r. 2.1-2.

binding on them, they may guide the Boards in their decision-making, indirectly increasing the significance of previous case law despite lack of doctrine of precedent.[44] The case law produced by the opposition procedures and the appeal procedures before the Boards of Appeal, then, may become subsequently "codified" in the Examination Guidelines.[45] The intentional (and to a degree, necessary) ambiguity and lack of detail of the EPC combined with the instructional yet unbinding nature of the Examination Guidelines creates a conundrum for the patent community: on the one hand, the Examination Guidelines create legitimate expectations and guide the applicants in the application process. On the other hand, the ambiguities of the EPC can be, at best, regarded as temporarily resolved by the instruction of the Examination Guidelines.[46]

## 2.3 THE BASICS OF PATENT LAW PROTECTION UNDER THE EPC

The basic requirements for the patentability of any invention are included in Article 52(1) EPC. This article embodies a distinctive feature of the European approach in that there is a requirement for there to be an invention that must be fulfilled before the claimed invention is even eligible for patent protection and before the other patentability criteria, such as novelty and inventive step, are even considered.[47] This is expressed by in Article 52(1) EPC:

> *European patents shall be granted for any inventions, in all fields of technology, provided that they are new, involve an inventive step and are susceptible of industrial application.*

The wording "in all fields of technology" is derived from the TRIPS Agreement's Article 27(1) prohibiting discrimination between fields of technology[48] and it was included in the EPC as recently as 2007. No explicit definition for what constitutes "technology" is given, reflecting the deliberate intention of the drafters of the EPC to not preclude adequate protection for the results of future developments technological innovations.[49] The European patent law tradition has, however, from its very conception, been based on a general understanding that patent protection should be

[44] Thambisetty (2017), at pp. 7-8,
[45] Schneider (2009), at p. 622.
[46] Thambisetty (2017), at pp. 6-8.
[47] Moir (2013), at p. 45.
[48] Moir (2013), at p. 65.
[49] Basic proposal for the revision of the European Patent Convention, document MR/2/00, at p. 43, para. 4; Bakels (2008), at p. 55.

reserved for technical innovation.[50] This notion has been considered as an implicit requirement of the EPC[51] and it has been confirmed by the Boards of Appeal numerous times.[52] Furthermore, the word "technical" is used frequently in patent legislation, further indicating that the framers of the EPC intended only technology to be patentable.[53] For example, Rule 42(1) of the Implementing Regulations of the EPC requires that the description of the claimed invention must specify the *technical field* of the invention and disclose the invention in such terms that the *technical problem* and its solution can be understood, and Rule 43(1) requires claims to define the matter for which patent protection is sought for in terms of *technical features* of the invention[54].

Despite the apparent significance an invention being technical, the EPC provides next to no guidance in positive terms what is required from an invention for it to be considered a technical creation for the purposes of Article 52(1) EPC. Rather, Article 52(2) EPC provides a list of subject- matters, which should not be regarded as inventions, and thus patentable, within the meaning of Article 52(2) EPC:

> *The following in particular shall not be regarded as inventions within the meaning of paragraph 1:*
>
> a) *discoveries, scientific theories and mathematical methods;*
> b) *aesthetic creations;*
> c) *schemes, rules and methods for performing mental acts, playing games or doing business, and programs for computers;*
> d) *presentations of information.*

However, Article 52(3) EPC specifies that the patentability of the listed subject-matters is excluded only to the extent they are claimed "as such", indicating that the listed exceptions should be interpreted narrowly[55] and that under certain conditions such inventions may still lead to the grant of a European patent:

> *Paragraph 2 shall exclude the patentability of the subject-matter or activities referred to therein only to the extent to which a European patent application or*

[50] Skulikaris (2013), at p. 4.
[51] European Patent Office, Patents for software? European law and practice (2009), at p. 9; Takenaka (2009), at p. 326.
[52] See e.g. decisions T 1173/97 (Computer program product/IBM) of 1.7.1998, summary, section VIII and T 0641/00 (Two identities/COMVIK) of 26.9.2002, r. 3.
[53] Bakels (2008), at p. 53.
[54] See also Examination Guidelines, F-IV, 2.1.
[55] Takenaka (2009), at p. 326.

*European patent application or European patent relates to such subject-matter or activities as such.*

As indicated by Article 52(1) EPC, once the existence of a patentable invention has been determined, it must then be determined whether the invention fulfils the conditions of novelty in Article 54 EPC, it must involve inventive step as set out in Article 56 EPC, and must be susceptible of industrial application as set out in Article 57 EPC. For the purposes of this work, the focus shall be on the *inventive step* requirement of Article 56 EPC, according to which it is assessed by determining, having regard to the state of art whether the invention would have been obvious to a person skilled in the art.[56]

Considering the general nature of the inventive step requirement, the EPO has, based on TBA case law, developed the so-called *problem-and-solution approach* to act as a methodology for the assessment of the presence of the inventive step in an objective and predictable manner, incorporated in the Examination Guidelines.[57] This approach does not have an explicit basis in the EPC, but it is consistent with Rule 42(1)(c) EPC, which prescribes that inventions must be disclosed in terms of a *technical problem and a solution*.[58] The Examination Guidelines present the approach in three steps: i) determining the closest prior art; ii) establishing the objective technical problem to be solved, and iii) considering whether or not the claimed invention, starting from the closest prior art and the objective technical problem, would have been obvious to the skilled person.[59]

As will be seen below, the Boards of Appeal have created a two-step (or two-hurdle) procedure, whereby the first step involves an evaluation whether the subject-matter of the claimed invention is an invention within the sense of Article 52 EPC. For apparatus claims, this is always the case; for method claims, if the claim involves technical means (such as the use of a computer), then the claim is considered to be an invention under Article 52 EPC. Only after the claims have passed the first hurdle will it be evaluated

[56] For the definition of skilled person and the level of knowledge such person is presumed to possess, see Examination Guidelines, G-VII, 3. Further, Article 83 EPC requires patent applications to disclose the invention in the claims "in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art".
[57] The leading decision in the EPO case law on this approach applied to claims comprising of technical and non-technical features being T 0641/00 (Comvik), discussed in detail in Chapter 3.2.
[58] Wisser (2019), in section 6 (Problem-solution approach).
[59] Examination Guidelines, G-VII, 5.

whether the claimed invention fulfils the remaining requirements under the EPC, including inventive step. The invention requirement is sometimes considered a primary requirement concerning the essential qualities of patentable subject-matter, whereas the other requirements are considered to form a separate and independent criteria regarding the "accidental properties" an invention may or may not have. Despite being governed by two different rules, in practice the evaluation of the two hurdles overlap.[60]

## 2.4 LOCATING SIMULATIONS IN THE PATENT LAW FIELD

### 2.4.1 DEFINITION AND APPLICATIONS

In order to assess the patentability of simulation methods, it is instructive to understand what simulations are. What is exactly the simulation-related invention claimed in Connor? The term "simulation" is variously defined[61] and used to convey many different meanings depending on the type of source, i.e. whether the source pertains to simulations from the point of view of the law or the technology itself. For example, various internet articles refer to the claimed invention in Connor as "simulation software"; in a more technical breakdown presented by Kruspig and Schwarz[62], simulations are classified under software, and more specifically under "system software" as opposed to "application software". Occasionally "virtual worlds" and "virtual systems" are labelled as simulated systems.[63] The numerous use cases and the constant development of new simulation applications render it difficult to assign a definition for the term, rendering it elusive to a non-technical person. Before looking into further where simulations fall in the landscape of the potentially patentable inventions, some important clarifications should be made from both perspectives.

In the book *Guide to Simulation-Based Disciplines*, containing a collection of approximately hundred definitions for simulation, the following basic definition is presented:

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[60] Pila, Justine & Torremans, Paul (2016), at pp. 171-172. See also T 0154/04, r. 5(d). (*"The four requirements invention, novelty, inventive step, and susceptibility of industrial application are essentially separate and independent criteria of patentability, which may give rise to concurrent objections."*)

[61] On the complexities related to the term "simulation", see Mittal et al (2017), at pp. 17-22. For a brief history of simulation software and analysis of potential future trends, see e.g. Solokowski et al (2019), at pp. 8-20.

[62] Kruspig and Schwarz (2016), at §2.06.

[63] Kruspig and Schwarz (2016), at §4.07.

> *Simulation is performing goal-directed experimentation or gaining experience under controlled conditions by using dynamic models; where a dynamic model denotes a model for which behaviour and/or structure is variable on a time base.*[64]

The Cambridge Dictionary provides a slightly more straightforward definition, defining a simulation as *"a model of a set of problems or events that can be used to teach someone how to do something, or the process of making such a model"*.[65]

*Simulation software* then, in the simplest terms, refers to a computer program that uses a set of mathematical formulas to model a real-life phenomenon with a set of mathematical formulas, which allows its user to observe the object of the simulation without having to performing it in the real world.[66] In addition to a mathematical model of a system to be simulated (a block diagram, schematic, state-chart, code, computational algorithm), an understanding of the nature of the simulated system or process (important parameters, relationship between these parameters) is needed for a computer program to calculate the behaviour of the model under different conditions and over time. A simulation software may include additional visualisation tools, such as data displays and 3D animation.[67] Simulations, in essence, provide a numerical solution to a real-world problem: they can be used to replace experiments with real-life physical systems or imagined ones with valid digital representations, enabling their users to analyse and have insight into complex systems real-life methods do not always permit.

Simulations are an extremely current and multifaceted topic in industry, academia, and beyond. Simulations have traditionally found most use in in various industrial fields and in engineering. As advancements in computer technology (faster hardware and improved software) and increases in the available computing power have made it possible to program and execute more complex computer-implemented simulations, they have become an inherent part of the execution of fairly complex tasks such as industrial design of products, buildings, machines and systems.[68] Even where the execution of the simulation manually may be an option, for example by constructing a physical prototype, saving time, resources and effort and the possibility to increase

[64] Mittal et al (2017), at p. 6.
[65] Definition of "simulation" in the online Cambridge Dictionary. Available at https://dictionary.cambridge.org/dictionary/english/simulation (last accessed 1.3.2020).
[66] Wikipedia article on Simulation software. Available at https://en.wikipedia.org/wiki/Simulation_software (last accessed 1.3.2020).
[67] Mathworks.se (undated); Arsham, Hossein (2015).
[68] Arsham, Hossein (2015).

productivity and capacity are important drivers for the adoption of computer-implemented simulations.[69] As a result simulations may be used as an alternative to the constructing of a physical prototype, often impractical due to high costs and large construction time requirements and contradicting the requirements of an efficient use of natural resources, to evaluate design properties so that the final product will be as close to the originally intended design as possible without having to undergo expensive modifications, but also to diagnose problems with an existing design without going through the trouble of having to reproduce the testing conditions in real life.[70] Certain conditions and characteristics related to experimentation may persuade or even necessitate the use of simulation: Sometimes, the real system does not exist or is not accessible, or the conditions are hard to reproduce for experimentation, such as the extreme conditions of space in the designing and testing of satellites or in the testing aircraft safety features,[71] or physical prototyping might be technically impossible for example in the case of evaluating the design properties of nuclear reactors.[72] Related to the topic of this work, simulation use in building design and engineering is sometimes presented as a practical example of simulation use in engineering, including applications such as the multi-agent simulation of crowds related to building evacuation or, predicting issues related to pedestrian flows[73], as is the case in Connor. Simulations are, interestingly, increasingly disengaging the work of engineers from the physical reality altogether: the work of many engineers today relates to systems whose output and input are only information and as such purely digital with no direct link to physical reality.[74]

Similarly, in the field of science and academia, simulations allow researchers to conduct experiments and try out alternatives, make substitutions and change variables in a safe, rapid and cost-effective fashion, before proceeding to conducting experiments in real life, for example in the field of drug development.[75] Simulations could also allow researchers better make observations in fields of study where this has traditionally been challenging due to the dynamics being very slow, such as in

[69] Sokolowski et al (2019), at p. 8.
[70] Amicus curiae brief by Bardehle Pagenberg, at p. 3
[71] Mittal et al (2017), at pp. 7-8.
[72] Amicus curiae brief by Bardehle Pagenberg, at p. 3; Mittal et al (2017), at pp. 7-8.
[73] Mittal et al (2017), at pp. 171-172.
[74] Amicus curiae brief by FICPI, at p. 3; Parminder, Lally (2020, Jul 15).
[75] Piotrowicz, Pawel (2019, Dec 2).

economic studies, or too fast, like in particle physics. Safety considerations could also necessitate simulation-based experimentation for example in the case of testing the potentially dangerous effects of medical agents to the human body or provide the only plausible way to conduct experiments that are not found socially acceptable by populace, such as experimentation with the education system.[76] Both conservative and progressive views exist according to which simulations can be regarded as landing somewhere between the territory of theory and experiment or as an entirely new mode of doing science, and they have applications in traditional fields, such as physics, chemistry and biology, but also for example in the field of social sciences.[77]

Simulations also have an increasing applicability in a variety of contexts and fields that are not technical in the traditional sense, ranging from systems design and analysis, training, experimentation, mission rehearsal, test and evaluation, to education and entertainment.[78] The use cases for simulations can be roughly in two: the *experimentation aspect* of simulation use relates to control strategies, prediction of action and performance, and product design; within the *experience aspect*, simulation (sometimes as virtual reality or augmented reality) is used for skills training, entertainment (simulation games), and sharing of knowledge and emotions (art and literature).[79] In particular, the integration of artificial intelligence allows for the simulation of different kinds of scenarios and environments, such as consumer retail environment to model the behaviour and performance of customers and employees, in the virtual.[80] Similarly, simulations may be used to mimic real-time response in the virtual worlds of computer games.[81]

Notably, computer-implemented simulations underlie several technologies that are usually considered radical or disruptive, like artificial intelligence and virtual reality, but they also have the potential to improve upon and reinforce the value of established technologies. Where computer-implemented simulations fall in the incremental innovation-radical innovation dichotomy is, thus, not entirely unequivocal.

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[76] Mittal et al (2017), at pp. 7-8.
[77] Kruspig and Schwarz (2016), at §4.07.
[78] Mittal et al (2017), at p. 26.
[79] Mittal et al (2017), at pp. 6-7.
[80] Arsham, Hossein (2015).
[81] Amicus curiae brief by FICPI, at p. 3.

### 2.4.2 SOME IMPORTANT DISTINCTIONS

Similarly to “simulations”, the meaning behind the various related terms, namely “software”, “computer programs” and “computer-implemented inventions” (and sometimes “computer-implemented methods”), varies depending on the type of source, i.e. whether technical, scientific, legal or, in particular, patent law, where they are often used interchangeably or in a mixed manner. Notably, the EPC does not define any of these terms. As a highly specialised legal discipline, patent laws, however, require patent lawyers and examiners to possess both legal and technical expertise. In learning materials produced by the EPO, *computer program* is defined as a sequence of computational steps, which may be performed by digital computer, written in a systematic notation known as programming language, usually referred to as “code”. *Software*, often used as a synonym to computer program, usually encompasses the media (e.g. CD) on which the software is stored on as well as the related documentation (e.g. a manual). *Algorithm*, on the other hand, is used to refer to a systematic procedure for accomplishing a task in a finite number of steps, and it can be understood as the concept underlying the computer program. In the context of computers, it denotes a set of ordered steps for solving a problem or providing an output from a specific set of inputs.[82]

However, Directive 2009/24/EC on the legal protection of computer programs, or the so-called Software Directive, concerning the copyright protection of computer programs in the EU Member States insofar as the underlying computer program code is concerned (as opposed to e.g. the innovative algorithm expressed by the code or other functional elements of the computer program), provides a definition. The Software Directive defines computer programs as *“programs in any form, including those which are incorporated into hardware”,* also covering their source object code and preparatory design material. The directive further states that *“[t]he function of a computer program is to communicate and work together with other components of a computer system and with users and, for this purpose, a logical and, where appropriate, physical interconnection and interaction is required to permit all*

[82] Course “Patentability of CIIs at the European Patent Office” by the E-learning Centre of the European Patent Academy, see slides no. 5-6.

*elements of software and hardware to work with other software and hardware and with users in all the ways in which they are intended to function"*.[83]

While the innovative algorithm expressed in the code is not covered by copyright protection for computer programs, it might receive patent protection. However, in the EPC, the term "software" is not used. Attention must be turned to Article 52(2) and (3) EPC, which prescribe that computer programs, among others, should not be considered inventions within the meaning given to them in the EPC if clamed "as such". Computer programs (or, synonymously, software), however, possess certain features that set them apart from the rest of the other exclusions, namely in that they may be used in the implementation of mathematical methods, business methods, rules for playing games, and other excluded subject-matters. This has created a dilemma for the EPO whereby the unconditional exclusion of computer programs would lead to all technical inventions implemented by computer programs being non-patentable, and their unconditional patentability would lead to a situation where all of the exclusions could be circumvented by the use of a computer program.[84]

Consequently, the questions of patentability of mathematical methods or algorithms arise rarely alone, as they are usually intrinsically linked to the computer program performing them. The claimed invention of Connor, a computer-implemented mathematical method and algorithm for simulation the movement of pedestrians, lands somewhere between computer programs, mathematical methods, and rules and/or methods for performing mental acts, all excluded under Article 52(2) EPC "as such" in this manner. To bring clarity to the nature and patentability of "mixed claims" comprising of features not excluded from patentability combined with features excluded from patentability if claimed "as such" as per Article 52(2) EPC, mainly to distinguish between patentable inventions from software, the Boards of Appeal introduced the notion of "computer-implemented inventions" (CIIs)[85]. The term was later adopted by the European Commission in its proposal for a directive, known as the Software Patents Directive[86], which aimed to provide a broad interpretation and a clear scope for CIIs, harmonising the related national patent laws and patent

[83] Directive 2009/24/EC, r. 7, 10.
[84] Skulikaris (2013), at pp. 4-5; Takenaka (2009), at p. 327.
[85] T 1173/97 (Computer program product/IBM) of 1.7.1998, as discussed in Ch. 3.1.2.
[86] Directive of the European Parliament and of the Council on the patentability of computer-implemented inventions (COM(2002) 92).

application practices in the EU.[87] The proposed EU directive explicitly defined CIIs as *"any invention the performance of which involves the use of a computer, computer network or other programmable apparatus and having one or prima facie novel features which are realised wholly or partly by means of a computer program or computer programs"*.[88] However, in July 2005, the European Parliament rejected the suggested directive almost unanimously, ending an intense three-year debate on the subject. A number larger IT companies, such as Microsoft supported the motion, whereas open-source software companies, most notably Linux, and smaller actors in the industry were against the motion. The main reason for the failure was reportedly the fear of "pure software" becoming patentable. [89] The term CII remains, however, widely used in Europe, encompassing a wide variety of different kinds of inventions.

# 3 A PATENT LAW STANDARD IN THE MAKING – THE TECHNICAL CHARACTER AND INVENTIVE STEP OF INVENTION

## 3.1 TECHNICAL CHARACTER REQUIREMENT

Unlike the wording "in all fields of technology" of Article 52(1) EPC, Articles 52(2) and (3) EPC were included already in the very first edition of the EPC.[90] According to the EPO, the common denominator of the listed subject-matters is that they lack a substantial *technical character*, a necessary feature of an invention for it to be patentable. As the EPC lacks a positive definition for what is to be considered "technical", the "as such" exclusion is interpreted as any subject-matter that does not have a "technical character", or opposite of "technical". [91] Although the expression "technical character" is not used in the EPC, its status as legal requirement of invention was expressly confirmed by the Conference of the Contracting States to Revise the European Patent Convention of 20 to 29 November 2000 and included in the Basic Proposal for the Revision of the European Patent Convention.[92]

[87] European Union: Study of the effects of allowing patent claims for computer-implemented inventions, Final Report and Recommendations to the European Commission, June 2008, at pp. 5-6.
[88] Article 2 of the Directive proposal.
[89] Software patent wars – Parliament rejects directive outright (Dec 12, 2006).
[90] 1st edition of the European Patent Convention (May 1979).
[91] Bakels (2008), at pp. 53-54.
[92] Basic Proposal for the Revision of the European Patent Convention, document MR/2/00. See T 0154/04, where the TBA provided a comprehensive overview of the legislative history behind Article 52(2) EPC, r. 8

The Boards of Appeal have noted that the formulation of Articles 52(2) and (3) reflect the recognition that creations related to engineering and technology should be entitled to patent protection and that practical scientific applications should be considered distinct from abstract ideas and intellectual achievements in general.[93] The Boards of Appeal have remarked that since the listing in Article 52(2) EPC is "in particular", it should be understood to be non-exhaustive and that all the listed subject-matters can be classified as abstract and non-tangible.[94] The legislator has explicitly left it for the EPO in its practice and case law to determine whether subject-matter claimed as an invention has a technical character and to further develop the concept of invention (i.e. whether the subject-matter at issue falls within the list of excluded subject-matters according to Article 52(2) EPC) in an appropriate manner and in the light of technological developments.[95]

The technical character threshold for patentability has fluctuated in the case law of the Boards of Appeal, producing contrasting results. In legal literature on the topic, generally three distinct approaches are detected, the categorisation of which varies somewhat. Commonly, three overall approaches are detected, the "technical contribution" approach, the "(further) technical effect" approach, and the "any hardware" approach[96], each of which have each then produced slightly varying results in different cases.[97] These developments have, at least in part, occurred as a result of the proliferation and evolution of computer technology, as the rise of patent applications for inventions that feature claims wholly or partially realised by the means of a computer program has given rise to the question under what conditions such a CII may escape the exclusion of computer programs as such under Article 52(2)(c) EPC.[98] As will be seen, although the inventive step requirement is distinct from the subject-matter eligibility, the EPO's manner of determining subject-matter eligibility for CIIs

[93] See e.g. T 0154/04, r. 8.
[94] T 0953/94 () of 15.7.1996 ("A method of functional analysis"), r. 3.1.
[95] Basic proposal for the revision of the European Patent Convention, document MR/2/00, at p. 43, para. 4.
[96] Exact grouping of decisions under the approached is challenging, as the approaches have not followed one another entirely linearly and as the TBA has rarely discarded its previous line of reasoning entirely. Moreover, some variation exists as to how the decisions are grouped in the sources discussing the approaches. Further differences exist as well: in addition to the technical contribution and further technical effect approaches, Skulikaris (2013) terms the TBA's line of reasoning beginning from Pension Benefits and continuing in Hitachi and Comvik as the "Hitachi-Comvik" approach. The any hardware approach is sometimes termed the "any technical means" approach, as in G 2/07 (Broccoli/PLANT BIOSCIENCE) of 9.12.2010, r. 6.3 and G 3/08, r. 10.6.
[97] Ballardini (2008), at p. 565.
[98] Ballardini (2008), at pp. 564-565.

overlaps with its inventive step requirement. In the following, the evolution of the technical character requirement shall be described through three main approaches, together with relevant further developments with regard to CIIs.

### 3.1.1 TECHNICAL CONTRIBUTION APPROACH

The first of these approaches has its basis in the landmark case T 0208/84 (Computer-related invention/VICOM).[99] The case concerned claims to a mathematical method for processing digital images and to an apparatus (such as a general-purpose computer) for carrying out the method. *Vicom* established the importance of the overall technical contribution of the invention as the baseline for examining computer-related inventions and remains influential to the European thinking on technical effect to this day.[100] In its decision, the TBA stipulated that an invention is patentable if it satisfies the "conventional patentability criteria" of the EPC and that such an invention should not be prejudiced against merely for the fact that its implementation required the modern technical means of a computer program. The TBA emphasised that the decisive factor should be what *technical contribution* the invention as a whole makes over the known art.[101]

This approach spells out two different types of possible outcomes: If this contribution falls exclusively within one of the categories of excluded subject-matter, there cannot be an invention within the meaning of Article 52(1) EPC. However, even if the invention is comprised of elements that by themselves are non-patentable, the invention as a whole may be patentable as a whole as long as a *technical contribution* is made to the known art.[102] Vicom's technical contribution approach was followed in decision T 0026/86[103] (Koch&Sterzel), which concerned image processing in the context of an X-ray apparatus, and in decision T 0059/93[104], which concerned a method for interactive rotation of displayed graphic objects. However, in decision T 0790/92[105], the presentation of a numerical chart, in particular a chart for business

[99] T 0208/84 (Computer-related invention) of 15.7.1986 (VICOM).
[100] Leith (2007), at p. 27; Marsnik & Thomas (2011), at p. 280.
[101] T 0208/84 (Vicom), r. 16.
[102] T 0208/84 (Vicom), r. 16.
[103] T 0026/86 (X-ray apparatus) of 21.5.1987.
[104] T 0059/93 () of 20.4.1994.
[105] T 0790/92 () of 29.10.1993.

purposes was seen as a solution without a technical effect as no technical problem was solved by it.

### 3.1.2 (FURTHER) TECHNICAL EFFECT APPROACH

The technical contribution approach was eventually met with opposition. Critics noted that the use of computer programs always involved the use of a computer, rendering the invention automatically technical. Moreover, the Vicom and Koch&Sterzel decisions had concerned combined apparatus and process or method claims, and the EPO still disallowed direct claims to "computer program products".[106] However, these issues received clarification and led to the emergence of a new approach, the so-called *technical effect approach*, articulated by the TBA in decisions T 1173/97 (Computer program product/IBM)[107] and T 0935/97 (Computer program product II/IBM)[108], relating to a "resource recovery in a computer system" and a "a method for displaying information" respectively, i.e. to the patentability of computer programs as such.

The *IBM I* and *II* decisions marked a shift in the EPO's focus from the mere physical interaction of hardware and software, resulting from the fact that a computer program must be run on a computer, to the actual functionality of the invention and the technical effect it produced beyond this basic interaction,[109] The TBA employed identical logic in the two decisions, considering computer programs as such to be mere abstract creations, lacking in technical character. Conversely, this meant that computer programs with technical character were potentially patentable. To distinguish between patentable and non-patentable computer programs, the TBA held that the normal interaction between a computer program and the machine executing it (such as internal electrical changes in the computer) was insufficient to produce a technical effect. More precisely, the TBA held that a computer program could be patentable *"[i]f the program, when running on a computer or loaded into a computer, brings about, or is capable of bringing about, a technical effect which goes beyond the 'normal' physical interactions between the program (software) and the computer (hardware) on which it is run"*.[110] Interestingly, since a computer program is able to produce a further

[106] Marsnik & Thomas (2011), at pp. 283-284.
[107] T 1173/97 (Computer program product/IBM) of 1.7.1998.
[108] T 0935/97 (Computer program product II/IBM) of 4.2.1999.
[109] Skulikaris (2013), at p. 6.
[110] T 1173/97 (IBM I), r. 13; T 0935/97 (IBM II), r. 13.

technical effect only when run on a computer, it was noted that a computer program's "potential" to produce this effect was sufficient.[111]

### 3.1.3 ANY HARDWARE APPROACH

To summarise the developments so far, the EPO has applied three concepts in the evaluation of the patentability of CIIs: the invention must make technical contribution; the invention must be evaluated as a whole to determine its technicality; and the invention must give rise a further technical effect.[112] However, the Boards of Appeal diverted from the technical contribution approach in decision T 0931/95 (Controlling pension benefits system)[113], in which claims to an application for a computerised method for doing business were regarded by the Examining Division to fall in their entirety within the exclusions under Article 52(2) EPC.

In *Pension Benefits*, the TBA criticised the earlier technical contribution approach for failing to appropriately distinguish between the requirement for an "invention" and other patentability criteria, namely inventive step and novelty, deeming the technical contribution approach not fit for determining whether an invention within the meaning of Article 52(1) EPC exists.[114] The TBA also held that a computer or a computer system, even when programmed to carry out a method that is non-patentable "as such", must be taken into consideration as "product" or "physical entity", that is, a technical article not excluded from patentability.[115] As a consequence, any patent application relating to a computer implementation, if the claims refer to some feature of the hardware, may be considered an invention for the purposes of Article 52(1) EPC, rendering the requirement of technicality, once again, easy to satisfy for CIIs.[116] However, the apparatus claim did not pass the inventive step requirement under the TBA's scrutiny.

The underlying reasoning of Pension Benefits was later extended in number of cases, although in a contradictory manner, most notably in T 0258/03 (Auction

[111] T 1173/97 (IBM I), r. 9.4; T 0935/97 (IBM II), r. 9.4.
[112] Marsnik & Thomas (2011), at p. 287.
[113] T 0931/95 (Controlling pension benefits system) of 8.9.2000.
[114] T 0931/95 (Pension Benefits), headnote 4; Skulikaris (2013), at p. 6.
[115] T 0931/95 (Pension Benefits), r. 5.
[116] Ballardini (2008), at p. 566.

Method/HITACH).[117] The claims in *Hitachi* concerned an automatic auction method executed on a server computer, and an apparatus for carrying out the method. With regard to the apparatus claim, following Pension Benefits, the TBA rejected the technical contribution approach, and held that the computer programmed to execute a business method passed the hurdle of Article 52(2) EPC as it involved clearly technical features ("such as server computer, client computers and a network").[118] With regard to the method claim, the TBA diverged from Pension Benefits, marking a partial shift in in the any hardware approach, holding that corresponding methods claim should not be excluded, even if they contribute solely to a field excluded from patentability, if they involve technical means. However, in Hitachi, both the apparatus and the method claims were regarded to not pass the inventive step requirement of Article 56 EPC: once the inventive but non-technical features were taken into account in the assessment of the inventive step, the claims were found to be obvious.[119]

The decision T 424/03 (Clipboard formats I/MICROSOFT)[120] proves an interesting diversion. Following the logic of Hitachi, the TBA found claims to a method enhancing the functionality of a Windows operating environment (predecessor of operating system) and a computer program executing it as a method using technical means and as such an invention. However, as opposed to moving on to the assessment of inventive step, in *Microsoft*, the TBA provided its reasoning for distinguishing the claim category of computer-implemented methods from that of computer programs, holding that even if the method is executed by a computer program (i.e. method only contributing to the excluded field of computer programs), the method claim does not claim a computer program *as* a computer program. Diverging from Pension Benefits and Hitachi, the TBA viewed that, once it is established that the claimed subject-matter involves a technical character (invention as per Article 52 EPC), the invention in its entirety should be taken into consideration, as opposed to being treated as part of the prior art, for the assessment of the inventive step (as per Article 56 EPC). Hence, only the code constituting the computer program was to be regarded as computer program as such; in contrast, the code embodied in the physical medium causing the computer

[117] T 0258/03 (Auction method/HITACHI) of 21.4.2004; Marsnik & Thomas (2011), at p. 289; Ballardini (2008), at p. 566.
[118] T 0258/03 (Hitachi), r. 3.7.
[119] Ballardini (2008), at p. 567.
[120] T 0424/03 (Clipboard formats I/MICROSOFT) of 23.2.2006.

to operate was regarded to have a clear technical effect, and therefore neither excluded from patentability nor forms part of state of the art for the purposes of assessment under Article 56 EPC.[121] The decision seemed to almost eradicate the exclusion of computer programs as such since under it all computer programs would possess the necessary technical effect once run on a computer. The TBA offered no further explanation for its diversion form Pension Benefits and Hitachi in its assessment for the inventive step, and the decision did not lead to the emergence of a new diverging approach in the EPO practice.[122] Some confusion persisted after Microsoft, but in a case decided soon after it, T 0154/04 (Estimating sales activity/DUNS LICENSING ASSOCIATES)[123], the TBA followed the any hardware approach in a more traditional manner.[124]

### 3.2 THE COMVIK-APPROACH – INVENTIVE STEP ASSESSMENT OF MIXED CLAIMS

Despite the slightly varied reasoning of the TBA under the any hardware approach, as a result, both apparatus and method claims satisfy the Article 52 EPC requirement for an invention without much difficulty. However, the approach did not relax or bring much clarity with regard to the inventive step requirement of Article 56 EPC. In decision T 0641/00 (Two identities/COMVIK)[125], the TBA set out to expand on how inventions relating to a mix of "technical" and "non-technical" subject-matters fulfil the requirement of inventive step under Article 56 EPC and how the problem-and-solution approach should be adapted to such mixed-type inventions. The headnote of *Comvik* provides two rules for the treatment of non-technical features of claims.

> *I. An invention consisting of a mixture of technical and non-technical features and having technical character as a whole is to be assessed with respect to the requirement of inventive step by taking account of all those features which contribute to said technical character whereas features making no such contribution cannot support the presence of inventive step.*
>
> *II. Although the technical problem to be solved should not be formulated to contain pointers to the solution or partially anticipate it, merely because some feature appears in the claim does not automatically exclude it from appearing in the formulation of the problem. In particular where the claim*

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[121] The TBA cited T 1173/97 (IBM I) in support of this finding, ignoring the fact that in IBM I, it was found that a computer program could be considered a technical means only if it produced a further technical effect (r. 5.3). See Marsnik & Thomas (2011), at pp. 292-293.
[122] Shemtov (2009), at p. 509; Ballardini (2008), at p. 567.
[123] T 0154/04 (Estimating sales activity / DUNS LICENSING ASSOCIATES) of 15.11.2006.
[124] Marsnik & Thomas (2011), at pp. 294-295.
[125] T 0641/00 (Two identities/COMVIK) of 26.9.2002.

*refers to an aim to be achieved in a non-technical field, this aim may legitimately appear in the formulation of the problem as part of the framework of the technical problem that is to be solved, in particular as a constraint that has to be met.*

Firstly, the TBA concluded that mixed-type inventions that have technical character as a whole are to be assessed with respect to the inventive step requirement by taking into account all features which contribute to its technical character. Conversely, features not contributing to the invention's technical character cannot be taken into account in the assessment of the inventive step, irrespective of how clever or non-obvious such non-technical features might be. Second, the TBA maintained that while such non-technical features could not contribute to the solution of a technical problem, the non-technical aspects of an invention can be used in the formulation of a technical problem included in the formulation of the technical problem as a "requirement specification", regardless of their novelty or innovativeness.[126]

## 3.3 INFINEON − TECHNICAL CHARACTER FOR SIMULATION METHODS AND REJECTION OF MANUFACTURING STEP

### 3.3.1 DECISION T 1227/05 (INFINEON)

The TBA's attention was turned specifically to simulation methods in decision T 1227/05 (Circuit simulation I/Infineon Technologies).[127] The invention in *Infineon* concerned claims to a computer-implemented simulation or modelling method for testing the performance of an integrated circuit under the influence of a 1/f noise[128]. The method claim comprised of mathematical formula generating random numbers and steps that produced an exact 1/f noise for the simulation. The claimed method was more efficient than other conceivable methods, as it required shorter computing times and less storage space. In addition, it made it possible to conduct the simulation on smaller computer systems, previously not powerful enough for that purpose, and to simulate larger circuits, the simulation of which was previously not possible at all.[129] In addition to the method, the application claimed a computer program executing the

[126] Examination Guidelines, G-VII, 5.4.2.1.
[127] T 1227/05 (Circuit simulation I/Infineon Technologies) of 13.12.2006.
[128] A type of low-frequency electronic noise that occurs in almost all electronic devices having a variety of negative effects on their performance. Wikipedia article on Flicker noise. Available at https://en.wikipedia.org/wiki/Flicker_noise (last accessed 24.11.2020).
[129] T 1227/05 (Infineon), summary, section IV(d).

method, a data medium holding the program, and a computer system on which the program was loaded.[130]

As the method was computer-implemented, it used technical means and by that very token was considered to have technical character; like CIIs in general, Infineon passed the first hurdle easily. For the second hurdle, the assessment of inventive step, the board slightly rephrased its previously established Comvik-approach: Beyond its implementation, a procedural step may contribute to the technical character of a method only to the extent that it serves a *technical purpose* of the method.[131] In the TBA's view, the simulation of a circuit subject to 1/f noise constituted an adequately defined technical purpose for a computer-implemented method, provided that the method is functionally limited to that technical purpose. It held that the simulation of a circuit with input channels, noise input channels and output channels whose performance was described by differential equations was functionally limited in such a manner (it concerned "*an adequately defined class of technical items*"). The simulation could be regarded as a "functional technical feature", whereas a "metaspecification" of an undefined technical purpose/system would not have been considered adequate.[132]

Additionally, the TBA held that the claimed circuit simulation method was not to be considered to constitute a mathematical method as such or a computer program as such, emphasising that, while an invention may be preceded by a mental or mathematical act, the claimed result must not be equated with this act. The TBA offered two reasons: 1) The claims related to a simulation method that could not be performed by purely mental or mathematical means, nor to the thought process that led to that simulation method. 2) The circuit simulation involved an additional technical effect since its output allowed the realistic prediction of the performance of a designed circuit and therefore allowed it to be developed accurately so that the prototype's chance of success could be assessed before it was manufactured. The TBA backed its reasoning by discussing the significance of computer-implemented simulation to modern engineering work, stating that they were a practical tool in electronic engineering rather than purely mathematical theories or mental acts. Hence, all steps relevant to

[130] T 1227/05 (Infineon), summary, section III.
[131] T 1227/05 (Infineon), r. 3.1.
[132] T 1227/05 (Infineon), r. 3.1-3.1.2.

the circuit simulation, including the mathematically expressed claim features, contributed to the technical character of the simulation method.[133]

Strikingly, the TBA went even further in this consideration by taking into account the relationship between simulations and physical, real-world effects. It noted that *"specific technical applications of computer-implemented simulation methods are themselves to be regarded as modern technical methods which form an essential part of the fabrication process and precede actual production, mostly as an intermediate step"*, concluding that simulation methods cannot be considered abstract and denied a technical effect merely on the ground that they do not yet incorporate the physical end-product.[134] The TBA specifically referred to and deviated from decision T 0453/91[135], a case concerning an application for a semiconductor chip design-method. In T 0453/91, the TBA specifically noted that the claims could be interpreted to merely deliver an image of something that would not necessarily ever exist in real world, i.e. the claimed method would not ever necessarily result in a physical entity. The only contributions made by the design steps made were in excluded fields, such as mental acts and their implementation by computer programs. Only after the claims were altered to involve an extra step for actually manufacturing the designed semiconductor chips, the TBA was ready to regard the claimed method as technical overall.[136] In other words, the reasoning of the decision allowed for computer modelling to be patented providing the claim also included a step for manufacturing a physical product in accordance with the computer model.

Although the TBA had previously held that the fact that one method is faster than another is not by itself enough to establish that the involved procedural steps are technical[137], in connection with Infineon, it noted that without the technical support of computer-implemented simulation methods to conduct virtual experiments, the testing of circuit designs would not necessarily be possible to the same extent, or at least not possible in reasonable time and that there is no "purely" mathematical, theoretical or

[133] T 1227/05 (Infineon), r. 3.2.1-4.
[134] T 1227/05 (Infineon), r. 3.4.2.
[135] T 0453/91 () of 31.5.1994 ("Method for physical VLSI-chip design").
[136] T 0453/91, r. 5.2-3.
[137] See decision T 1954/08 (Marketing simulation/SAP) of 6.3.2013, as referenced in the Case Law of the Boards of Appeal, I-A, 2.3.4 f.

mental method that could realistically substitute testing done with the help of computer-implemented simulations.[138]

### 3.3.2 CURRENT APPROACH AND THE EXAMINATION GUIDELINES

What could, then, an inventor wishing to file a patent application for a computer-implemented simulation expect the status of computer-implemented simulation methods under the EPC to be? In summary, the TBA has considered the patentability of simulation methods following the general principles used to evaluate CIIs in general: As per the Comvik-approach, by being at least partially computer-implemented, the claimed subject-matter of the simulation method as a whole is not excluded from patentability, passing the first hurdle of Article 52(2) EPC. The approach to the second hurdle of the inventive step requirement has been established in Infineon.

Further support is provided by the most recent edition of Examination Guidelines from 2019, which introduced a new subsection under "mathematical methods", providing specific guidance relating to the patentability of inventions related to simulation, design and modelling. The Examination Guidelines identify computer simulations specifically in their examples of patentable inventions, stating that claims directed to methods of simulation, design or modelling typically comprise of features which fall under the category of mathematical methods or of methods pertaining to mental acts but, since these methods are at least partial computer-implemented, the claimed subject-matter as a whole is not excluded from patentability. Moreover, Infineon is cited in the EPO Case Law Book and the Examination Guidelines explicitly reference the case, specifying that computer-implemented simulation methods cannot be denied a technical effect merely on the ground that they precede actual production and/or do not comprise a step of manufacturing the physical end-product.[139]

Following Infineon, the TBA has created a body of case law concerning non-technical processes that did not pass Infineon's test, confirming that a technical system must be specified in the claim and the purpose of the modelling must be technical. A marketing campaign, an administrative scheme for transportation of goods[140] or determining a

[138] Case Law of the Boards of Appeal, I-A, 2.3.4 f.
[139] Examination Guidelines, G-II, 3.2.2; Case Law of the Boards of Appeal, I-A, 2.3.4 f.
[140] See T 0306/10 (Relationship discovery/YAHOO!) of 4.2.2015. A method of scheduling tasks in an industrial process was regarded non-technical. The mere possibility of serving a technical purpose or of solving a technical problem is not sufficient to avoid exclusion under Article 52(2) and (3) EPC.

schedule for agents in a call centre[141] are provided as negative examples of systems and processes the simulation of which does not have a technical purpose. As positive examples, computer-implemented method of designing an optical system using a formula for determining technical parameters such as refractive indices and magnification factors for given input[142], and an iterative computer simulation to determine a maximum value for an operating parameter of a nuclear reactor are provided[143]. It is explicitly mentioned that limiting the simulation to a "simulation of a technical system" too generic. Interestingly, the Examination Guidelines also note that "*[i]n the context of computer-aided design of a specific technical object (product, system or process), the determination of a technical parameter which is intrinsically linked to the functioning of the technical object, where the determination is based on technical considerations, is a technical purpose*".[144]

However, considering the multitude of different kinds of simulation methods currently being developed, the two examples mentioned in the Examination Guidelines do not necessarily capture all of them and potentially give rise to uncertainty as to their technical nature or lack thereof. Computer-implemented simulation methods can be applied to the simulation of both technical and non-technical objects, and limiting the patent claims to a specific technical field is generally not relevant for applicants. In practice, this uncertainty with regard to the patentability of simulation methods has led to the emergence of a practice, in a quite obvious contradiction to the Examination Guidelines and the established EPO practice, whereby patent applicants formulate their claims to state that the method is intended to simulate a technical system or process, but do not further specify the purpose of the simulation.[145] No further

[141] See T 1265/09 (Call center/IEX) of 24.1.2012. Skills-based scheduling for telephone call centers was considered to solve no technical problem; did not "result in any technical effects which relate to the operation of the telephone call center" (r. 1.3).
[142] See T 0471/05 () of 6.2.2007. The decision concerned the general design of an optical system, viewed to have no technical character. After the addition of the support of a computer, the whole method was considered to solve a technical problem.
[143] See T 0914/02 () of 12.7.2005. The decision concerned a method for the designing of a core loading arrangement for loading nuclear reactor fuel bundles into a reactor core to optimise several process parameters was considered a mental act. After the addition of "a suitably programmed computer" to the claim, the method was considered to have a technical character.
[144] Examination Guidelines, G-II, 3.3.2.
[145] Leleu, Charlotte & Loisel, Bertrand (2020, Jan 15).

rationalisation or additional examples are provided in the Examination Guidelines for the restriction of generic purposes.[146]

### 3.4 CONNOR − PATENTABILITY OF SIMULATION METHODS

#### 3.4.1 DECISION T 0489/14 (CONNOR)

As already alluded to in the very beginning of this work, the subject-matter of the decision T 0489/14 (Pedestrian simulation/CONNOR) relates to a computer-implemented method, computer program and apparatus for simulating the movement of a pedestrian crowd through an environment, where the simulated movement of each pedestrian included a "provisional path" through the modelled environment, a variety of obstacles in a pedestrian's path and a number of functions ("dissatisfaction", inconvenience" and "frustration") eventually determining the pedestrian's next "preferred step".[147] With reference to Infineon, the applicant held that the simulation constituted an adequately defined technical purpose for a computer-implemented method. The simulation could be used as a design aid in the building of a train station or a stadium, for example.[148] The first instance Examining Division rejected the patent application without considering prior art because it was of the opinion, following the approach set out in Comvik, that all of the claimed method steps were non-technical and as such could not be considered for assessing inventive step. An appeal was filed against the decision.

During the appeal, the TBA unsurprisingly found that claim 1 avoided exclusion under Articles 52(2) and (3) EPC by the virtue of being a "computer-implemented method", but held that the implementation of claim 1 on a computer was straightforward, requiring "only basic knowledge of data structures and algorithms", and that its implementation did not result in specific technical effect. To assess if the claim fulfilled the inventive step criteria, the TBA's attention then turned to whether it had any *further* technical aspects going beyond its implementation on a computer. In this

[146] Although the restriction may be viewed to be in line with Rule 42(1) and Rule 43(1) of the Implementing Regulations, discussed in Ch. 2. In contrast, a specific example is provided by the guidelines of the French National Institute of Industrial Property, which stipulate that a simulation "of a physical phenomenon in an environment" lacks technical purpose due to not having concrete technical application or technical characteristics linking it to a specific technical system. The French guidelines specifically note that such a simulation may be used to simulate both physical and non-physical phenomena. See Leleu, Charlotte & Loisel, Bertrand (2020, Jan 15).
[147] T 0489/14 (Connor), summary, section IX.
[148] T 0489/14 (Connor), r. 2.

respect, the TBA found the claims of the application to be crucially lacking: the claims did not imply that the invention required any direct "input" from any real-world environment or for an actual building structure to exist in it, nor did they assert that the claims would produce any direct "output" to the real world, for example by informing the design process of an existing environment or a building, or one that could exist in the future; it only produced information about simulated pedestrians moving in a simulated environment. The appellant countered the TBA's view by stating that the claim provided a further technical effect in the form of "a more accurate simulation of crowd movement", maintaining that the results of simulating the movement of pedestrians were no different from those obtained by modelling an electron using numerical methods, claiming that the simulation of pedestrians, too, was at least partially based on the laws of physics. While the TBA did not disagree with the appellant's observations, it expressed doubts as to whether the task of numerically calculating the trajectory of an object as determined by the laws of physics was always technical or able to produce a technical effect. Instead, it held that such an effect requires, at minimum, a direct link with the physical reality, such as a change or measurement of a physical entity.[149]

While the TBA agreed with the applicant in that the Infineon-approach could be applied in the case, it nevertheless presented two reasons to deviate from it. Firstly, in line with Infineon, the TBA maintained that a computer-implemented simulation, regardless of whether it concerns a simulation of a noisy circuit or an environment, is a tool that can perform a function "typical of modern engineering work". However, it held that such simulation only assists the engineer in the cognitive process of verifying the design: while the circuit or environment, once realised in practice, may be a technical object, the design verification process preceding it is fundamentally non-technical. Secondly, it viewed that in Infineon, the TBA had relied on the greater speed of the computer-implemented simulation method as an argument for finding technicality. The TBA objected this by stating that carrying out an algorithmically specified procedure on a computer is, quite naturally, faster than carrying out the same method mentally. This, however, does not provide a technical contribution going beyond mere computer implementation.[150]

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[149] T 0489/14 (Connor), r. 9-11; Baker, Anton (2019, Dec 23).
[150] T 0489/14 (Connor), r. 15.

Noting the diversion in case law, the TBA referred the following questions to the EBoA:

> *1. In the assessment of inventive step, can the computer-implemented simulation of a technical system or process solve a technical problem by producing a technical effect which goes beyond the simulation's implementation on a computer, if the computer-implemented simulation is claimed as such?*
>
> *2. If the answer to the first question is yes, what are the relevant criteria for assessing whether a computer-implemented simulation claimed as such solves a technical problem? In particular, is it a sufficient condition that the simulation is based, at least in part, on technical principles underlying the simulated system or process?*
>
> *3. What are the answers to the first and second questions if the computer-implemented simulation is claimed as part of a design process, in particular for verifying a design?*

### 3.4.2 REFERRAL G 1/19 − WHAT DO THE QUESTIONS ACTUALLY MEAN?

What do the questions referred by the TBA, then, actually ask?[151] In the first referred question, the TBA effectively requested the EBoA's view on whether the Comvik-approach, widely accepted in the assessment of the inventive step for CIIs in general, is applicable to computer-implemented simulation methods. To recap, under the Comvik-approach, processes using mathematical calculations performed by a computer would be regarded as non-technical features of an invention, not contributing to the inventive step and resulting in the claims relying on these features being rejected as not patentable under Article 52(2)(c) EPC. However, the Boards of Appeal have established that if the claimed non-technical feature is somehow contributes to or affects the physical reality (for example, by controlling external physical equipment, as in T 0026/86 (Koch&Sterzel) or by influencing the properties of a physical entity, such as the digital images in Vicom), it is able to produce a technical effect and the non-technical rejection is, thus, overcome.

Now, the TBA appears to have put to put to question whether simulation methods are patentable at all: do all kinds of simulation methods lack a technical effect specifically because such a direct link to the physical world is missing? Inversely, the TBA is asking confirmation from the EBoA that the non-technical feature rejection is overcome if the simulation method solves a technical problem in a way that provides

[151] The referred questions have produced an array of interpretations, presented both in the amicus curiae briefs and in various internet commentaries. See e.g. amicus curiae brief submitted by Dr. Stefan Schohe, dated 1.9.2019, at pp. 12-13 or Piotrowicz, Pawel (2019, Dec 2).

technical effect outside the simulation.[152] This inquiry, in turn, raises the question of how immediate such effect would have to be, as the simulation and the operation causing the change in the physical entity might take place in different location, at different times and by different parties.[153] It could be perhaps argued that such link as a necessary requirement could provide a litmus test for determining the presence of technical effect.[154]

While the EBoA's answer to the first question may be the most impactful one, the second question appears most complex of the three. Where the first question seeks to determine if computer simulations when claimed as such can give rise to a technical effect in the first place, in the second referral question the TBA appears to be inquiring, should the EBoA answer the first question in affirmative, what necessary boundaries must be drawn for the patentability of simulation methods, for example with regard to the nature of the simulated system or process. Must a simulation be of a sufficiently technical process, or can a simulation be "functionally limited to a technical purpose" in the first place? This consideration seems particularly salient in the case of Connor: the patent application claims the modelling of pedestrian movement through a building structure, not necessarily excluding the non-technical applications of the simulation, such as the simulation of pedestrian movement in building structures to optimally positions commercial premises.[155]

The third and final question referred to the EBoA sets out to inquire about a situation where a computer-implemented simulation is claimed as part of some larger process, and in particular a design process. Could such a process be found to be inventive solely because it makes use of a computer-implemented simulation?[156] The question seems most relevant to the claims of the Fourth Auxiliary Request under the appeal where the claims are directed to a method of designing (a model of) a building structure. In the decision, the TBA noted that, since the technicality of the invention in Infineon was so closely linked to the significance of computer-implemented simulations for modern product development processes, this limitation "arguably strengthens the

[152] G1/19: Are simulations inventive? (2019, Aug 28).
[153] Jennings, Mike (2020, Jan).
[154] Davies, Simon (2019, Oct 24).
[155] Leleu, Charlotte & Loisel, Bertrand (2020, Jan 15); amicus curiae brief submitted by Philips International B.V., at p. 5.
[156] G1/19: Are simulations inventive? (2019, Aug 28).

appellant's case".[157] The answer to the last question could be particularly important for artificial intelligence- and machine learning-based inventions, potentially widening their sphere of patentability.[158]

### 3.4.3 REASONS FOR REFERRAL − REVERSAL OF INFINEON AND "DIRECT LINK WITH PHYSICAL REALITY"

Now, despite the established line of case law, in Connor, the TBA the viewed that it could not decide on the case without potentially creating conflicting case law and legal insecurity. Although the TBA noted that that there are similarities between Infineon and Connor, it expressed doubts as to what extent the reasoning applied in Infineon could be used, stating that *"both the question of patentability of simulation methods would be a point of law of fundamental importance and the Board's intended deviation from the interpretation and explanations of the EPC given by T 1227/05 would justify a referral of the following questions to the [EBoA]"*. The TBA observed that industrial simulation methods are gaining ever more economic significance, but it was yet *"hesitant to base its decision on policy considerations relating to the appropriate scope of patent protection that have not been expressed by the legislator"*.[159] While the TBA's observation that simulation methods are becoming increasingly important, is not deciding the case outright in accordance with the Infineon-approach and referring the case to the EBoA the only conclusion the TBA could have reached? Whether there is truly a need for referral shall now be examined.

First of all, the TBA has not always taken such an uncertain stance. For example, in T 0603/89 (Marker), the TBA did not refer a question of supposed contradiction between the Examination Guidelines and its intended decision to the EBoA, stating that such a supposed contradiction was not a ground for making a referral and that it considered itself able to answer it "beyond any doubt by reference to the Convention".[160] In opinion G 3/08, concerning the patentability of computer programs, the EBoA held the question 3(a) referred to it, "[m]ust a claimed feature cause a technical effect on a physical entity in the real world in order to contribute to the technical character of the claim?", inadmissible. The EBoA regarded that there was no divergence on this point between decisions T 163/85 and T 190/94, according to which a technical effect on "a

[157] T 0489/14 (Connor), r. 26.
[158] G1/19: Are simulations inventive? (2019, Aug 28).
[159] T 0489/14 (Connor), r. 16.
[160] T 0603/89 (Marker) of 3.7.1990, r. 3.5-3.6.

physical entity in the real world" was necessary condition for a feature to contribute to the technical character of an invention, and decisions T 125/01 and T 424/03, according to which the technical effects can be essentially confined to the respective computer programs.[161]

Secondly, in Connor, the TBA appears to aim to introduce a requirement for technical effect in the form of "direct link with physical reality" for simulation methods, possibly in form of a manufacturing step or similar. The TBA, for example, emphasised that the "potential" technical effect of a computer program found in IBM I to nevertheless be something that is assessed against the invention's potential to affect the physical reality.[162] While Connor is the first case the TBA has explicitly articulated its doubts as to whether the approach set forth in Infineon should be followed, it has in decisions succeeding Infineon noted that the leap the TBA took from the decision T 0453/91 by waiving the requirement for a manufacturing step is not necessarily entirely conducive. For example, in a comparably recent decision T 0988/12[163], the TBA noted that a computer-implemented simulation essentially comprises of a model running on a computer to assess or predict the functioning of a system, and that it may be difficult to discern the technical effect such process might have. It considered this to be the case especially since the simulation does not have any technical effect on the simulated system or process, in particular considering that the simulated system or process may never, neither before nor after the simulation takes place, exist in physical form. The effect of running a simulation on a computer does not go beyond the normal effects of running a computer program on a computer. Nevertheless, the TBA noted that, in light of the Infineon-approach, the requirement of a physical link had been waived and moved its attention to whether the claimed invention was adequately defined. [164] The Boards of Appeal have applied the Infineon-approach in a similar manner in a number of cases related to computer-implemented simulations, rendering the approach a well-established one.

[161] As referenced by the TBA in T 0489/14 (Connor), see r. 31. According to the EBoA, in T 163/85 and T 190/94, it was merely accepted that technical effect on a physical entity as something sufficient for avoiding exclusion from patentability; they did not state that it was necessary. See G 3/08, r. 12.1-4.
[162] T 0489/14 (Connor), r. 36.
[163] T 0988/12 (Network deployment simulator/ACCENTURE) of 17.7.2018.
[164] T 0988/12, r. 2.3-6.

It could even be argued that by upturning the case T 0453/91 and its previous approach to the requirement of a manufacturing step in Infineon, the TBA diverged from equating technicality from physicality in a broader sense than ever before – a development the TBA appears now to have been willing to reverse. Although the early landmark decision Vicom did not specifically concern a computer-implemented simulation method, it provides an interesting starting point: In searching for the claimed invention's technical contribution in Vicom, the TBA held that a method for processing digital images was neither a mathematical method as such nor a computer program as such, positing that "applied" algorithms used in a technical process were to be distinguished from w "pure", abstract mathematical algorithms.[165] The TBA found that the claimed mathematical method represented a digital filter that influenced the properties of digital images and that those images were to be considered as a "physical entity" of the real world.[166] Thus, it viewed that the method was related to an image processing system and that it could not be considered an abstract method dealing with numbers without any special meaning and without any relationship to any technical system. The TBA confirmed that a mathematical method may be an invention if the method is part of a technical process, and that such a technical process is different from a mathematical method in that the technical process is carried out on physical entity and provides, as its result, a certain change in that entity. Vicom's example was followed by the TBA in case T 0953/94, where it held that computerised method for generating data analysis of the cyclical behaviour of a curve, a mathematical expression, was to be considered as non-technical when the curve was generated from abstract data and business data. However, the TBA appears to have indicated that it would have been allowable if the method was limited to parameters restricted to "physical" or "technical entities".[167]

Regardless, in Connor, the TBA referred to Vicom specifically as a case that is relevant in assessing the need for requirement of a direct link with physical reality.[168] However,

[165] Ballardini (2008), at p. 565.
[166] T 0208/84 (Vicom), r. 5. *"In contrast thereto, if a mathematical method is used in a technical process, that process is carried out on a physical entity (which may be a material object but equally an image stored as an electric signal) by some technical means implementing the method and provides as its result a certain change in that entity. The technical means might include a computer comprising suitable hardware or an appropriately programmed general purpose computer."*
[167] T 0953/94 () of 15.7.1996 ("A method of functional analysis"), see r. 3.5.
[168] T 0489/14 (Connor), r. 32.

this was not the case in T 0531/09[169], a case related to a computer-implemented simulation, where the TBA reasoned that Vicom's definition of a technical process – a process that is carried out on a physical entity and that provides a certain change in that entity – did not cover simulations whose purpose is "to replace physical entities with virtual ones". The TBA appears to have implied that it viewed Vicom's reasoning not to be suitable when it came to the assessment of applications like simulation methods that could potentially obviate the need of creating a physical entity in the first place, and noted that the TBA had solved this issue in Infineon by waiving the requirement of a manufacturing step. Instead, Infineon had created a new test: the simulation of an adequately defined class of technical items could be a functional technical feature.[170]

Thirdly, in Connor, the TBA paid mind to the scope of the term "simulation". It considered the claimed invention to comprise a simulation "in a strict sense", considering a simulation in such a case to be *"an approximate imitation of the operation of a system or process on the basis of a model of that system or process. In the case of a computer-implemented simulation, the model exists only in the computer and the simulation allows the functioning of the modelled system or process to be assessed or predicted"*, noting, however, that the EBoA could very well adopt a broader definition in its answers.[171] Moreover, the TBA noted that mathematical simulation methods have been an issue at European national courts, deliberately contrasting its chosen definition of a "simulation" with those of the Logikverifikation decision of the German Federal Supreme Court (cited by the TBA in Infineon in support of that decision) and the Halliburton decision (decided in accordance with the Infineon-approach) of the UK Patents High Court. In *Logikverifikation*, the German court considered a method for verifying the layout of integrated circuits via a computer a step within the process of production of the circuits. Given the type of products involved, the invention was considered result of technical considerations and as such patentable. In *Halliburton*, the Court found a method for the designing of a drill with the help of a simulation to be patentable despite the absence of claims referring to the

[169] T 0531/09 (Checkpoint simulation/ACCENTURE) of 3.5.2012.
[170] T 0531/09, r. 3.
[171] T 0489/14 (Connor), r. 21.

actual manufacturing of the drill.[172] Further, the TBA admitted that the eventual answers of the EBoA are important not just for the present case but for a potentially large number of cases involving computer-implemented simulations[173], but seemingly also for those that are not simulations in the "strict sense".

In this regard, it is notable that, although Connor does concern a type of simulation that arguably is further from the technical reality of the real system under Infineon since the simulation is implemented in a fictional building that may never exist, the TBA does not attempt to distinguish the two cases from each other by explicitly suggesting that the physical nature of the semiconductor device in Infineon and the subjective behaviour of a pedestrian in Connor are different in a way that results the former being patentable and the latter non-patentable. In addition, the TBA also does not take a stance on the claim by the applicant that the designing of an environment, or more specifically a building, qualifies as a technical purpose. Instead, the TBA seems to view that Infineon has been wrongly decided altogether.[174]

# 4 THE EBOA PROCEEDINGS

## 4.1 INITIAL VIEWS AND ADMISSIBILITY OF THE REFERRAL

As alluded to before, the referral garnered a substantial amount of attention and reactions, all seemingly critical of the TBA's approach and, in particular, the various amicus curiae brief expressing support for the EPO's continued application of the Infineon-approach for the simulation of technical systems and processes.[175] Most notably, the EPO President in their comments remarked that technical knowledge required from a skilled person in a relevant technical field to create the simulation should be prioritised over considerations for a direct link with physical reality. Simulations which reflect the underlying technical principles provide approximate

[172] BHG, X ZB 11/98, GRUR 2000, 498 - Logikverifikation and Halliburton v Comptroller-General of Patents [2011] EWHC 2508 (Pat), as referenced by the TBA. As referenced in by the TBA in T 0489/14 (Connor), see r. 46-48.
[173] T 0489/14 (Connor), r. 19.
[174] Davies, Simon (2019, Oct 24).
[175] The briefs submitted by actors supporting the EPO's continued application of the Infineon-approach include, among others, IP Owners Association, IP Federation, European Federation of Intellectual Property Agents in Industry (FEMIPI), European Federation of Pharmaceutical Industries and Associations (EFPIA), and organisation Chartered Institute Of Patent Attorneys (CIPA), European Patent Institute (EPI) and the International Association for the Protection of Intellectual Property (AIPPI).

imitation of the simulated system or process irrespective of any direct physical input or output to the simulation, producing data of the object of the simulation.[176] Answering the first referred question in affirmative the EPO President concluded that, based on identical reasoning, it could also be inferred that a simulation being at least partially based on the underlying technical considerations is a sufficient condition and that there was no need to answer the third referred question separately.[177]

Based on the views presented, the EBoA communicated its initial views on the case, including its own reformulations of the three referral questions by the TBA, in its communication preceding the oral proceedings:

> *1) Can the COMVIK-approach be used in the assessment of computer-implemented simulations?*
>
> *2) If answered in affirmative, what specific considerations should be applied to computer-implemented simulations? In particular, to what extent is it possible to treat "potential" or "virtual" technical effects as "real" technical effects? How do the exclusions of "mental acts" and "discoveries, scientific theories and mathematical methods" interact with simulations and their constituent parts (namely, models represented by equations and algorithms to solve such equations).*
>
> *3) Does the technical purpose of the simulation have to be reflected in the patent claims? Lastly, is there a difference between simulations based on "human behaviour" and simulations based on "natural phenomena"?*

Quite expectedly, the EBoA reformulated the TBA's first referral questions in terms of the applicability of the Comvik-approach to computer-implemented simulation methods. As for the second referral question, despite the fact the submitters of the amicus curiae briefs expressed overwhelming support for the continued application of the Infineon-approach to computer-implemented simulation methods, the EBoA observed that two different, although not mutually exclusive, lines of reasoning could be inferred from them, appearing to suggest that the Infineon-approach is not necessarily sufficient and that something more is needed. The EBoA noted that the first of these approaches assumes that a technical process or system is simulated in a realistic manner, advocating a view that "virtual" technical effects the simulation method may have should be equated with the corresponding "real" potential technical effect, whereas the second approach assumes that simulation methods should be patentable if serve as tools for achieving a specific technical purpose. The EBoA, thus,

[176] G 1/19 – Comments by the president of the EPO, paras. 28-30.
[177] G 1/19 – Comments by the president of the EPO, paras. 43, 47.

reformulated the TBA's second referral question in terms of potential and virtual technical effects, also noting the significance of the other subject-matter exclusions of Article 52(2) EPC.

The discussions at the oral proceedings began with the question of the admissibility of the TBA's referral questions themselves. Noting that in the previous referral over computer programmes, G 3/08, the referred questions had focused heavily on admissibility, the EBoA indicated that it did not consider the uniform applicability of the law based on Infineon to be at stake to the same degree as the TBA in the present referral. Concurring with both the appellant and the representatives of the EPO President, the EBoA gave its preliminary view that the first and the third referral questions should be considered admissible. As for the admissibility of the second referral question, the EBoA divided it into a part (a), the first sentence, and a part (b), the second sentence, indicating that it was ready to consider at least part (b) admissible. As for part (a), the EBoA suggested that the TBA had worded the question in broader terms than was necessary for the TBA to decide on the case. The discussions pertaining to the last referral question by the TBA on the treatment of simulation methods claimed as part of a design process were somewhat brief, the views of the appellant, the representatives of the EPO President and the preliminary views of the EBoA indicating that there should be no special treatment of simulations claimed as part of a design process, and a consistent approach should instead be followed. In the following, the most salient aspects based on the points raised in by the appellant and the EPO representatives during the oral proceedings shall be discussed.

### 4.2 TECHNICAL PURPOSE

During the oral proceedings, the appellant held that the TBA had in Infineon set out a practicable test for evaluating the technical effect of computer-implemented simulations by requiring the simulation to have a technical purpose, which the TBA could have readily applied in Connor instead of looking for physical link. In other words, the appellant likened the notions of technical purpose and technical effect to the two sides of the same coin: if a computer-implemented simulation has a technical purpose, it must follow that it has a technical effect, maintaining that that the EBoA should confirm this. However, the appellant noted that there is currently an uncertainty as to whether the Infineon-approach would limit the patentability of computer-implemented simulations that are application-agnostic, i.e. simulations that have multiple technical applications, or whether it would be possible for the drafters of patent claims to formulate the claims of such application-agnostic computer-implemented simulations in a manner that would fulfil the requirements of being "functionally limited to a technical purpose" and "adequately classified". The appellant further elaborated that, in the assessment of technical purpose, identifying designer of the simulation (for example, an engineer) and their motivation (for example, to improve on a manufacturing process) could be of importance.

### 4.3 TECHNICAL EFFECT - POTENTIAL AND VIRTUAL EFFECTS

In connection with discussions regarding the second referral question, arguments concerning the treatment of "potential", or "real", technical effects" and "virtual" technical effects were raised. In the discussions, potential virtual effects were construed as technical effects an invention could have, if implemented in the real world. The appellant specifically referred to IBM I, a pre-Comvik decision, where the TBA held that "program product is not excluded from patentability if it possesses the *potential* to bring about 'further' technical effect"[178] as an example of a case where such potential technical effect was found, giving rise to an argument that any effect arising from the use of the computer-implemented simulation for its intended purpose is a technical effect. Virtual technical effect, in contrast, would then be the kind of a technical effect the simulation method of Connor might have, that is, technical effects arising within the simulation but not necessarily ever outside of it.

An example contrasting the two types of technical effects presented during the oral proceedings concerned the physical simulation versus virtual simulation of an aircraft wing[179] and the effect of turbulence on such wing, where it was noted that simulating turbulent conditions in wind tunnels is often inadequate as the complex airflows caused by turbulence are difficult to mimic. However, a sufficiently realistic effect may be achieved by rotating different kinds of structures in front of the wings. While a method of physically simulating an aircraft wing subject to turbulence in a wind tunnel may comprise of steps to building a model of the wing, to test the model in a wind tunnel

[178] See Ch. 3.1.2. T 1173/97 (IBM I), r. 9.4-5, 10.1 and T 0935/97 (IBM II), r. 9.4-5, 10.1.
[179] While it was not explicitly mentioned if the example pertained to a simulation method that has already been developed, it appears that such simulations do exist. See e.g. Radespiel, Rolf et al.: Simulation of Wing Stall. Conference Paper, June 2013, 43rd AIAA Fluid Dynamics Conference. Available at https://www.researchgate.net/publication/259903254_Simulation_of_Wing_Stall (last accessed 24.11.2020).

using the rotating structures to create the turbulence and airflows and to measure the airflow over the model of the wing. In contrast, claims to an analogous computer-implemented simulation would comprise of steps to build a numerical model of the wing and the rotating structures and to create a computer-model of the airflow over the wing. Importantly, both the physical simulation and the virtual simulations created to solve the same technical purpose and as an output, produce information about the wings functioning under the simulated conditions based on which a real scaled-up model of the wing may or may not ever be produced in practice.

During the proceedings, both the appellant and the representatives of the EPO President argued in favour of not distinguishing between the potential and virtual effects, maintaining that the EBoA against Infineon would deny patent protection from the latter. The first case would hardly be denied patent protection under the EPC; why should the second be? Effects in virtual reality, i.e. virtual representations of technical effects to solve technical problems and which can be used to solve the very same technical problem in physical reality, even when the data produced by the simulation is left for the user to apply, could be regarded as counting towards the invention having technical effect.

## 4.4 SIMULATIONS AND NON-INVENTIONS − INTERACTION WITH MENTAL ACTS, DISCOVERIES, SCIENTIFIC THEORIES AND MATHEMATICAL METHODS

Next, the significance of the exclusion of mental acts on the one hand and the exclusion of mathematical methods and scientific theories on the other in the assessment of the technical effect of computer-implemented simulations was discussed during the oral proceedings. According to the Comvik-approach, the mere fact that a feature in a claim relates to a non-invention listed in Article 52(2) EPC does not automatically imply that the feature is to be ignored in the assessment of inventive step for being non-technical. However, it was explicitly noted during the proceedings that in the assessment of a simulation's relation to technicality and the inventive step, to which of the excluded non-inventions of Article 52(2) EPC the computer-implemented simulation pertains to may be relevant, as some of the excluded subject-matters relate to technology more closely than others. For example, computer programs, scientific theories and mathematical methods generally have a greater propensity to serve a technical purpose than mental acts. Moreover, it was noted that, in evaluating this and the relevant criteria for assessing whether a computer-implemented simulation claimed as such solves a technical problem, it may be useful to consider the features a claim directed to a computer-implemented simulation may potentially comprise of. Namely, a claim concerning a computer-implemented simulation, depending on the nature of the simulation, may contain some but not necessarily all of the following features: the model of a technical system or process, the steps to obtain the model of the technical system or process, features specifying the algorithm used to compute the output based on the model, features directed at implementation of the model on a computer, the output of the of the technical system or the process, and possibly features specifying the purpose of the simulation.

In a simulation, the part most closely corresponding to a mental act is the model of the object or process being simulated. As mentioned previously, in Connor, the TBA put forward a possible objection to the patentability of computer-implemented simulations based on the mental acts exclusion by suggesting that, should the fact that the simulation method is performed on a computer be left aside, the steps of the simulation method if considered on their own could constitute a method for performing mental acts as such and as a consequence, the simulation method would not be technical.[180] The TBA appears to have come up with this possibility following the logic of the old paper-and-pencil test.[181] However, the simulation method can often be distinguished from the modelling method, which usually precedes the simulation method and only serves the purpose of the simulation method.[182] If that purpose is technical, the model contributes to the technical character of the invention and must be taken into consideration in the assessment of the inventive step.[183] However, it may be argued, as was done by the appellant in the oral proceedings, that computer-implemented simulations that provide information about the technical properties of a technical process or system and are based on the underlying technical principles of that process

[180] T 0489/14 (Connor), r. 4.

[181] See Examination Guidelines, G-II, 3.5.1: If the steps of a method claim could all be performed purely mentally, the exclusion of mental acts as such applies even if the claim encompasses technical embodiments or is based on technical considerations.

[182] See Examination Guidelines G-II, 3.3.2. In case the output of a computer-implemented method is *"merely in an abstract model of a product, system or process, e.g. a set of equations"*, this by itself is not sufficient to produce a technical effect even if the object of the model is a technical product, system or process.

[183] Following the Comvik-approach; also embodied in Examination Guidelines G-II, 3.6.2 with regard to information modelling: an information model can contribute to the technical character of the invention if it is intentionally used to solve a specific technical problem.

or system do not necessarily constitute methods for replicating mental activities. Instead, they should be considered as a way to virtually replicate measurements and experiments accurately and reliably in a manner that is comparable to and can replace the need to conduct such measurement in physical reality. Put differently, computer-implemented simulation may provide an alternative solution to a technical problem that could in theory be solved in physical reality and, as such, could be regarded equally susceptible to patent protection.

As for mathematical methods, scientific theories and discoveries, it was argued that, while mathematical methods applied to physical parameters, as opposed to mathematical methods operating on purely abstract entities, i.e. numbers and mathematical constructs, are no longer excluded from patentability "as such", this does not automatically establish that the computer-implemented simulation has a technical character, as the consideration of physical parameters may fall within the realm of scientific theories or discoveries in the sense of Article 52(2)(a) EPC. Similarly, the replication of experiments and measurements conducted in a computer-implemented simulation does not automatically distinguish such experimentation from experimentation made for scientific purposes. For example, in case T 1798/13, a patent for a concept of improving a weather forecast based on specific weather measures was considered non-technical as the object of the simulation, specific weather measures such as temperature, precipitation and wind speed, were regarded to not constitute a technical system that could be simulated with the purpose of trying to improve it. Rather, the TBA viewed that that the modelling of weather constituted a discovery or a scientific theory.[184]

Another potential obstacle posed by the exclusion of scientific theories and mathematical methods is that, even if they are used to solve a technical problem, they may not in themselves provide a solution that is considered to be technical enough. While a solution to a technical problem based on a mathematical method or a scientific

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[184] T 1798/13 (Forecasting the value of a structured financial product/SWISS …) of 25.5.2020. See r. 2.9 and r. 2.10: *"The applicant's second argument is essentially that also an improvement in the weather data by calculating and further processing it is also technical. In the Board's view this leads to the key issue in this case, namely whether improving the accuracy of given data of a weather forecast is technical. If it is not, then the details of the algorithm, the "mathematics" as the division put it, does not help. - - The Board judges that it is not. The "weather" is not a technical system that the skilled person can improve, or even simulate with the purpose of trying to improve it. It is a physical system that can be modelled in the sense of showing how it works. In the Board's view, this kind of modelling is rather a discovery or a scientific theory, which are excluded under Article 52(2)(a) EPC."*

theory but not involving any technical means would be considered as constituting a method for performing mental acts as such, if the claims were limited to a situation where the steps are carried out on a computer, the solution would not be excluded from patentability.[185] This approach has been adopted, for example, in Hitachi[186] and in decision T 0914/02[187].

### 4.5 SIMULATIONS, HUMAN BEHAVIOUR AND NATURAL PHENOMENA

During the oral proceedings, the relationship between simulation, human behaviour and natural phenomena was also discussed. [188] Following the Comvik-approach, if the simulated system or process is not technical and is based on, in part or entirely, human behaviour or natural phenomena, it is not automatically excluded from patentability and may, under certain conditions, make a technical contribution. However, whether or not such a feature relating to a non-invention contributes to the technical character of a claim is markedly difficult, as sometime explicitly noted by the TBA. For example, in case T 1749/06, the Examining Division held that an effect that depended only on the perception of the viewer ("happens in the brain of the viewer") related to presentation of information and was therefore to be considered non-technical. The TBA, however, held that such a test was not useful in determining whether a feature contributes to the technical character or a claim or not.[189] However, the representatives of the EPO President put forward a differing opinion during the oral proceedings, holding that this line of reasoning may be useful in assessing the technical effect of computer-implemented simulations. For example, the rendering methods in computer graphics often involve the simulation of laws of physics (optics) to create realistic light effects that enable the creation of digital images that appear photo-realistic to the

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[185] As affirmed by the representatives of the EPO President during the oral proceedings.
[186] T 0258/03 (Hitachi). See Ch. 3.1.3.
[187] T 0914/02, see r. 2.3.6: *"The distinction between methods of performing a mental act 'as such' and methods of performing a mental act having technical character may be drawn where the method provides a tangible technical effect, such as the provision of a physical entity as the resulting product or a non-abstract activity, such as through the use of technical means."*
[188] According to the TBA, the three referred questions correlated with the ones proposed by the appellant, although the TBA set aside the appellant's question on the extent to which claim features based on psychological considerations could make a technical contribution, see r. 29 of T 0489/14 (Connor). The appellant proposed the following formulation: *"Can a computer-implemented method of simulation involving values which represent physical quantities which can be influenced by or driven by non-physical factor(s) (such as aggregated human behaviour) and yet still be accurately simulated and be technically relevant such that the simulation is still able to aid the design of technical aspects of the physical system or technical product or the technical operation of the physical system or technical product still be considered to be or to serve a technical purpose provided the technical purpose is adequately defined[?]"*, see summary, section VII.
[189] T 1749/06 () of 24.2.2010 ("Three-dimensional icons for graphical user interface"), r. 4.2.2-3.

human eye; what the digital image depicts and whether it has any counterpart in reality should be irrelevant in the assessment of technical effect.

Another example provided during the oral proceedings concerned the already mentioned decision T 1798/13, in light of which it seems that it could very well be argued that the simulation of human behaviour has a scientific purpose rather than a technical purpose. However, following the applicant's reasoning of technical purpose, the answer could be different: the claimed invention must have a technical effect if its purpose is to improve a technical system or process and in evaluating the technical purpose and whether the simulation is wholly or in part based on natural phenomena or human behaviour does not bear any significance. For example, as argued by the appellant, the underlying purpose of the simulation in Connor was to simulate the movement of pedestrians to improve a building structure. The responsibility to make the necessary differentiation would, naturally, rest with the drafter of the patent claims: in case a computer-implemented simulation is limited to a technical system or a process (for example, the operational behaviour of a technical system under experimental conditions) and it is required to produce technical information about the simulated system or process as an output, the object of the simulation is distinct from a scientific endeavour and should be considered as sufficiently specific, or "adequately defined", as set out in Infineon.

### 4.6 POTENTIAL OUTCOMES

Naturally, it is possible that the EBoA fully agrees with the TBA's reasoning in Connor, effectively overturning Infineon and rendering a large number of simulation-based inventions non-patentable, even if based on the amicus curiae briefs and the views presented during the oral proceedings it is highly likely that this approach would not receive a warm welcome. However, it appears relatively straightforward that the EBoA would have trouble justifying an additional requirement of a direct physical link, at least if it intended to base is arguments on the EPC from which no such requirement can be directly derived. Rather than the question of a physical link or differentiating simulations from mental acts as such, it seems more likely that the EBoA will provide guidance on how should computer-implemented simulation methods should be assessed with regard to mathematical methods, discoveries and scientific theories, as the algorithm and model used in computer-implemented simulation are often based on these non-inventions excluded under Article 52(2) EPC as such. As simulation methods may be used in multiple fields of technology, a balance must be stricken, so that the patentability of computer-implemented simulations will not prevent the use of mathematical methods or scientific theories, as this would be contrary to the purpose of the exclusions. A potential solution suggested during oral proceedings by the EPO President's representatives: Limit the simulation to be only about a technical process or system, for example the operational behaviour of technical system under experimental conditions, and require the simulation to provide technical information about that simulated system or process.

As for the patentability of computer-implemented simulations based on human behaviour, the Infineon-approach combined with a requirement for a computer-implemented simulation to reflect concrete technical principles underlying the simulated system or process appears attractive and would certainly provide some clarity. By way of example, in the context of training self-driving cars, a simulation of human behaviour (which, by itself, is rather a scientific purpose than technical purpose) in traffic may be needed for a technical purpose and used to solve a technical problem, at least to the extent such a simulation can be regarded to be able to provide a certain level of realistic and reliable data. It has also been suggested that simulating an economic process could be used to solve a technical problem such as improving computer network load distribution, i.e. the allocation physical resources, memory and computation time, by simulating human behaviour at an auction by considering the computing units as economic agents placing bids for computing tasks.[190]

Regardless, the Infineon-approach, even if modified, does not necessarily solve the issue of assessing technical effect for computer-implemented simulation methods entirely: Further questions could arise, for example, with regard to the patentability of computer-implemented simulations that pertain to machine learning. Looking at future technological trends, while the classical methods of experimentation and designing are currently being replaced by computer-implemented simulations, computer-implemented simulations tend to still rely on models based on technical understanding of the simulated system or process. However, the emergence of machine learning could potentially obviate the need for technical consideration as we tend to generally understand them by replacing models based on technical understanding of a process or a system (so-called physical model) with general models, such as neural networks,

[190] Examples provided by the representatives of the EPO President during the oral proceedings.

which are based on the data the neural networks are trained on but cannot be considered to be based on any identifiable technical considerations. Considering this, while technical considerations and principles may be helpful in assessing the technical effect of certain computer-implemented simulations, they should not necessarily be regarded as rigid requirements.

While it is possible to speculate, it remains a fact that there is nothing in the EPC or the Examination Guidelines tying the Boards of Appeal to their previous positions if they are minded to overturn them − or tying the EBoA to the views presented by the TBA or the appellant. Although based on the oral proceedings it appears that the EBoA is not necessarily construing the questions referred to it as wider policy questions, its final position will not be known until its final decision is made public. In the meanwhile, the consideration both behind Connor and beyond it are worth examining.

# 5 CONSIDERATIONS BEHIND CONNOR

## 5.1 THE EPO AS A POLICY MAKER

In the previous chapters, various countervailing considerations regarding the patentability of CIIs and computer-implemented simulation methods in particular have been discussed. It is noteworthy that this has been possible despite the EPC setting out a general set of rules covering the patentability of all inventions, form every industry and field of technology. In the terms of Burk and Lemley, the EPC and most other patent laws are usually technology-neutral, as opposed to technology-specific. The technology-neutral nature of patent laws, however, resides only on the surface, as in practice, patent laws and rules are applied differently to different industries and technologies. Burk and Lemley present a number of existing and potential flexible patent law standards they call "policy levers", which allow courts to apply patent law in a technology- or industry-specific manner.[191] Some of these policy levers operate on "macro-level", treating different industries differently in an obviously technology-specific manner, while others operate on "micro-level", treating certain types of inventions receiving differently regardless of the specific technology or industry they

[191] One example being the "person having ordinary skill in the art" (PHOSITA) standard used to evaluate if an invention fulfils the non-obviousness criteria under various patent laws, notably U.S. Patent Law, comparable to the skilled person in Article 56 EPC. See Burk & Lemley (2003), at pp. 1648-1651.

pertain to, allowing the development of wider approaches on a case-by-case basis.[192] Burk and Lemley do not find the combination of technology-neutral patent law and technology-specific application of it condemnable. On the contrary, they find that it allows courts to exercise the necessary discretion to incorporate technology-specific (or industry-specific) consideration into their decisions. The alternative of abandoning flexible policy levers in favour of creating tailor-made, technology-specific patent law and, consequently, limiting the discretionary space courts have, would negatively affect patent laws' role as the primary policy tool incentivising innovation.[193]

The EPO jurisprudence ranging from Vicom to Infineon could be considered as evidence demonstrating that European patent law possess the necessary flexibility and open-endedness, and is suitably technology-neutral, allowing the EPO to adapt to unforeseeable technological advancements. These features, however, do not come without contradiction: On the one hand, debate exists whether computer program-related patents granted by the EPO truly possess any technical effect and if the Boards of Appeal are attempting to find new ways to circumvent the excluded subject-matter prohibitions, of Article 52(2) EPC has been put to question.[194] On the other hand, the Boards of Appeal limiting the patentability of certain types of innovation non-patentable − as is now the case with computer-implemented simulations − has been considered to evidence that Article 52(2) EPC is merely a "legal fiction" under which innovations that might be otherwise regarded as inventions under the EPC are not regarded as such for reasons unrelated to its inventiveness, thwarting the legitimate expectations of the patent community.[195]

In Infineon, the TBA demonstrated a deliberate willingness to extend technical character and provide patent protection to subject-matter, in this case a mathematical method implemented on a computer program, that it considered to warrant patent protection but that could have, using different kind of reasoning, been denied it for not being technical.[196] The TBA included deliberate public policy considerations to its decision in noting the significance of computer-implemented simulation methods in modern engineering and by explicitly enumerating that no physical end product was

[192] Burk & Lemley (2003), at p. 1641.
[193] Burk & Lemley (2003), at pp. 1630-1638, 1674.
[194] See e.g. Moir (2013), at p. 65; Sterckx & Cockbain (2010), at p. 368.
[195] Sterckx & Cockbain (2010), at p. 373.
[196] Shemtov (2017), at pp. 183-184.

needed, viewing that this warranted the upturning of the decision T 0453/91.[197] This appears to be in line with the purposeful open-endedness and flexibility of the "all fields of technology" as per Article 52(1) EPC and the TBA's designated role as the interpreter of the EPC in line with technological developments. However, should the EPO's role in making such major policy decisions through its case law be readily accepted? This question appears salient now that the TBA has in Connor demonstrated a clear willingness to depart from its previous reasoning and to establish a new hurdle for the assessment of inventive step that would affect a vast variety of emerging technologies that base on computer-implemented simulations.

Against Burk and Lemley's work, the question is not so much about whether the courts (or, patent offices) are the perfect patent policy makers, but whether they are the only instance able to do the task.[198] The problematic aspect of this approach lies in the fact that (U.S.) courts are not employing it consciously and with clear intention, but rather accidentally and haphazardly, without regard to the potential policy consequences their discretion may have.[199]Although in Connor, the TBA did not explicitly discuss or base its reasoning on policy consideration to the same degree it did in Infineon, it is seems reasonable to assume that such considerations may have influenced the TBA's decision to submit a referral to the EBoA. It was noted during the oral proceedings by both the appellant and the representatives of the EPO President that some of the amicus curiae briefs emphasise rather the underlying economic implication the approach the EBoA will adopt will have as opposed to how the EPC should be interpreted.[200] Considering that the EPC, previous case law, and opinions expressed in the amicus curiae briefs provide scant support for the establishment of a physical link requirement for incentive step and that the TBA did raise the question whether computer-implemented simulation methods should be patentable at all, it appears that the TBA may be foreseeing, but not necessarily clearly enunciating in so many words, an ever increasing usage of computer-implemented simulation methods and the subsequent expansion in the sphere of patent-eligible inventions, as will be discussed next.

[197] Shemtov (2009), at p. 513.
[198] Burk & Lemley (2003), at p. 1668.
[199] Burk & Lemley (2003), at pp. 1579, 1674.
[200] This could be argued to be the case e.g. in the amicus curiae brief submitted by Bardehle Pagenberg, where it is noted that simulation methods are of major importance to the European economy and the referral's implications in this regard are specifically discussed, see pp. 3-4.

## 5.2 MAINTAINING PATENT LAW COHERENCY VS. EXPANSION OF PROTECTION

The expansion of the patent eligibility of certain technologies, including CIIs, is a phenomenon acknowledged by legal scholars and the EPO itself. Examples of criticism are easy to come across. The TBA's adoption the various approaches to the exclusion of computer programs as such have been described as "a slippery slope" that has led to the EPO adopting multiple contradictory interpretations, allowing a broader spectrum of inventions to meet the technical requirement while never providing a solid legal definition of "technical contribution."[201] Shemtov in particular has regarded Infineon as a significant erosion of the computer program exclusion.[202] From the perspective of rightsholders, the expansion of patentable inventions may be a two-edged sword: On the one hand, obtaining patent protection for inventions such as CIIs is arguably an attractive mode of intellectual property protection, as patents offer irrefutable advantages compared to, for example, copyrights and trade secrets, as independent invention is no defence to patent infringement, and they offer protection for ideas and concepts that that might be refused copyright protection.[203] On the other hand, if patent protection is or becomes available for a given type or field of technology, industry players may find themselves might feel pressure to seek patent protection for their inventions as a defensive mechanism. This is particularly evident in the software industry, where many players who have expressed their skepticism for software patent protection have also actively sought patent protection for their software inventions.[204]

As suggested by Burk and Lemley, this expansive trend is not necessarily, at least entirely, a result of a conscious process on the EPO's behalf. In their analysis on the decision-making modalities of patent offices, Thambisetty concludes that the interpretation processes of patent offices are generally subject to increasing returns process, or self-reinforcing positive feedback loop, where the steps taken down a given sequence of legal reasoning tend to lead to further steps down the same path. In the early stages of such incremental process, for example when unprecedented technology is presented to a patent office in a patent application, a number of possible interpretations of a patent law provision may be present.[205] The complexity and

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201 Marsnik & Thomas (2011), at pp. 276-277.
202 Shemtov (2009), at p. 507.
203 Shemtov (2017), at pp. 160-161.
204 Sterckx & Cockbain (2010), at pp. 367-368.
205 Thambisetty (2009), at pp. 15-16.

opacity of the decision-making process lead to a situation where once, perhaps arbitrarily, selected path becomes relatively locked-in, and the initially created advantages and disadvantages become perpetuated, sometimes leading to contradictory or even absurd outcomes. Combined with the expectation of legal certainty, the reforms of such self-reinforcing interpretative paths as are difficult to reverse.[206] Moreover, the existence of such alternate and equally viable interpretative paths to questions on patentability, such as the exclusions of computer programs "as such", calls into question the doctrinal coherency of patent systems. Thambisetty considers doctrinal incoherence, the lack of legal certainty how a particular question will be decided and the legal reasoning presented supporting the assessment either way, as a sub-optimal outcome of these processes.[207] Such doctrinal incoherence may result from a variety of factors, including when various implicit or explicit interpretations exist in case law, or when the attributes and knowledge of the notional person skilled in the art are not sufficiently understood and, consequently, construed wrongly.[208] Same could be argued to be the case for the potential separation of computer-implemented simulations methods from other CIIs: in an amicus curiae brief submitted by Dr. Bakels, the EPO's various approaches to the computer program exclusion are regarded as "paradoxical", possibly evidencing that the approach of the Boards of Appeal to interpreting the EPC is fundamentally wrong.[209]

Employing a similar line of logic and using the concept of inventive step and the notion of a "threshold" for invention as examples, Gibson argues that much of the discourse informing patent law expects innovation to have a determinable sense of direction. In requiring the identification of the closest prior art and the determining of the technical effect brought about by those distinguishing feature(s), patent law promotes a logical and observable trajectory of innovation. While pragmatic, this is unable to sufficiently take into account the finer nuances of how invention come into being and how the availability or non-availability of patent protection affects it, like the controversial practice of ever-greening through improvement patents in the pharmaceutical field, or the significance of incremental innovation in the field of CIIs.[210] When the innovation is unanticipated, the patent system expects the innovation to be fitted in the existing

[206] Thambisetty (2009), at p. 21.
[207] On doctrinal incoherency, see also Pila's commentary on the referral G 3/08. Pila (2011), at p. 212.
[208] Thambisetty (2009), at p. 9.
[209] Amicus curiae brief by Dr. Reinier D. Bakels, at p. 7.
[210] Gibson (2014), at pp. 66-67.

system using a linear, hierarchical reasoning, which may, if too rigid, lead to erroneous outcomes or artificial barriers to entry.[211]

The gradual and somewhat linear modality of the development of the EPO jurisprudence has been noted by the Boards of Appeal themselves. In the referral G 3/08, in evaluating the admissibility of the referral under Article 112(b) EPC and the meaning of "different decisions", the EBoA remarked that the shifts in the EPO jurisprudence have taken place over an extended period of time, justifiably and as is inherent to all legal activity.[212] In contrast, the TBA now questioning the patent eligibility of computer-implemented simulations could perhaps be regarded as a more straightforward attempt by the EPO to correct the previous course of developments, even if it happens at the cost of undermining the legal certainty of provided by the established case law. Presently, the EBoA's eventual answers to the referral questions are a case in point in this regard, as they may result either in simulation methods being fitted into the existing framework, perhaps with slight modifications, or in the established line of reasoning being overthrown entirely. Hence, while the EBoA's notion of gradual development of case law in G 3/08 may be accurate to a degree, the first referral question in G 1/19, suggesting the establishment of a physical link requirement, appears more policy-laden than anything.

## 5.3 INSTITUTIONAL DESIGN OF THE EPO

As alluded to above, criticisms of the EPO's role in diluting the patentability standards exists. Schneider observes that several features how patent offices, including the EPO in particular, typically function contribute to this. Patent law and patent offices both serve dual functions: Patent law is a hybrid in the sense that it is an act of public law that creates a private property entitlement; similarly, patent offices execute law and grant legal entitlements and, through their decisions, can either narrow or widen the scope of patentability. Most significantly, although patent offices act in public interest, they are prone to "regulatory capture", whereby their activities tend to be dominated by their most active and represented customers, the patent applicants, who, for obvious reasons, are usually pro-patenting.[213] In addition, the financial independence of the

[211] Gibson (2014), at pp. 87-88.
[212] G 3/08, r. 7.3.6. For example, the EBoA held that the TBA diverging from T 1173/97 (IBM I) in T 0424/03 (Microsoft) was a "legitimate development of case law", r. 10.12.
[213] Schneider (2009), at p. 620.

EPO may be regarded as an enabling factor: it is financed by the procedural fees covering its activities, the renewal fees of pending patent applications and half of the renewal fees coming from granted patent applications.[214] Similarly, Moir attributes the patent law definition of inventiveness having become irrelevant for the purposes of patent policy as the general business incentive for patent offices is to expand their scope, driving them to employ an ever-expansive view on what constitutes a technical effect and, in the process, rendering the purpose of the inventive step standard close to being void. [215]

Plomer and Schneider pay particular attention to the role of the Boards of Appeal. Although the Boards of Appeal are independent, they are an integrated part of the EPO's organisation, operating parallel to the review mechanisms offered by national patent offices.[216] Consequently, the EPO acts as a quasi-court, both the judge and the jury of its decisions to grant patents.[217] The self-referential nature of the EPO's processes is also present within the Boards of Appeal: The members of the Boards of Appeal are often originally patent examiners and possess both legal and technical expertise, and their training requires the adoption of a special rationality and a set of assumptions and conventions particular to patent law. These assumptions and conventions, inherent to the system, are then used to solve issues stemming from within the system itself.[218] Moreover, the Boards of Appeal deal with appeals related to specific technical areas, allowing the members to take a collegiate approach to processing appeals.[219] As a result, the Boards of Appeal are able to employ a technocratic approach, which may be argued to be both necessary for the efficient functioning of the EPO but also to serve to conceal the impact their decisions have on the economic, social and political dimensions underlying European patent policies.[220]

Hence, substantive changes are either the result of the administrative practice of granting patents and the interaction between the patent applicant and patent examiners, or the result of the interaction between the examining departments and the quasi-jurisdictional appeal bodies of the EPO. The manner the EPO adjusts substantive

[214] Schneider (2009), at p. 620; Skulikaris (2013), at p. 2; Thambisetty (2009), at pp. 19-20.
[215] Moir (2013), at pp. 164-165.
[216] Moir (2013), at p. 45.
[217] Plomer (2019), at pp. 61-66; Schneider (2009), at pp. 622-623.
[218] Schneider (2009), at p. 621.
[219] Leith (2007), at pp. 26-27.
[220] Plomer (2019), at pp. 61-62.

patent law to new technological fields, especially the interpretation of the basic patentability thresholds such as inventive step as laid down in the EPC, can be regarded both as a tacit yet significant policy making practice.[221] Despite not being strictly binding on national patent offices, due to the move of patent applications from national patent offices to the EPO, its relative autonomy and acceptance of its authority by national courts, and the fact that the Boards of Appeal (in addition to the EPO President) have the ultimate authority to refer questions to the EBoA, the practical effect of the EPO's decisions is significant and national courts tend to follow EPO decisions although they are not mandated to do so. Direct dialogue between national patent offices and the EPO is often described scant.[222]

## 5.4 THE EPO AS TECHNOLAW MAKER

The notion of the EPO's technocracy − public policy decisions having been left in the hands of the EPO's technical experts without public oversight − appears not entirely unfounded. Firstly, European patent law does not necessarily evolve to accommodate new technologies through legislative action. Rather, this happens through the EPO continuously interpreting and reinterpreting the EPC's patentability requirements when granting patents, and through the insulated nature of the EPO's referral process, where the opposition procedures and the decisions of the EBoA form "case law" (officially termed as such by the EPO), which is later "codified" in the Examination Guidelines.[223]

Secondly, the open-endedness of the EPC's language means that the Convention itself provides little practical guidance to patent applicants when formulating patent claims, which ultimately define the scope of legal protection conferred by a patent. Consequently, the Examination Guidelines have a crucial role in how patent claims are formulated by them, an effect that has not gone unnoticed by the TBA itself.[224] This is amplified by the fact that applicants may amend the claims of their patent applications.[225] While this is permissible, Moir observes that minor amendments to claims wording are also done solely with the intention to make inventions fit the

[221] Schneider (2009), at p. 620.
[222] Moir (2013), at p. 45.
[223] Schneider (2009), at p. 622.
[224] Thambisetty (2017), at pp. 12-13. Noted by the TBA e.g. in case T 1607/08 () of 13.6.2012 ("Method for arranging compressed video data for transmission over a noisy communication channel"), see r. 2.1-2.
[225] See Article 123 EPC and Examination Guidelines, H-IV and V.

requirements of the Examination Guidelines better, labelling amendments that do not reflect any real changes in the invention "semantic changes".[226]

The significance of the Examination Guidelines, the EPO's understanding of technology, and the role of language used in patent law and patent claims are extensively discussed by Thambisetty. Thambisetty considers "technolaw" as one of the specialised features of patent law, implying that, due to its connection to rapidly developing technologies, patent law involves more *constructed* meanings that lack connection to the actual substance of the law than any other area of law, one salient example being the EPC's requirement of inventive step.[227] Although inventive step, which decides whether a technical advance is sufficient for the grant of a patent, is ultimately a legal standard, whether a supposed invention actually fulfils this standard usually requires technical expertise and evidence.[228] Accordingly, the inventive step requirement as presented Article 52 EPC has been described as a hybrid criteria, as opposed to purely technical one, requiring both the technical aspects of the patent claims and the invention's merits, as in whether it meets legal threshold to be granted a patent, to be evaluated.[229] An additional layer of complexity is added by other competing values such as public health goals, free competition, and human dignity.[230]

The Examination Guidelines, then, effectively become the instrument through which the EPO communicates its legal position on issues the EPC remains ambiguous about, such as the exact requirements of the inventive step standard, and through which these views become accumulated and distributed further.[231] Describing the Examination Guidelines as "a prosaic guide to legal standards, [which] transforms contested inventive matter and methods into patent claims",[232] Thambisetty considers the EPO producing the Examination Guidelines an example of "textualisation": disputed patent law standards as resolved by the EPO, when included in the Examination Guidelines, create expectations of the continuity of and bring legitimacy to the line of the EPO's reasoning. However, as the Examination Guidelines rarely reference purpose or

[226] Moir (2013), at pp. 101-102. See Ch. 6.3 for discussion on T 0339/13 (Immersion) for an example of a case where the applicant amending the claims had a significant effect on the TBA's evaluation of an invention's patentability.
[227] Thambisetty (2009), at p. 8.
[228] Thambisetty (2017), at pp. 19-21.
[229] Plomer (2019), at p. 65.
[230] Thambisetty (2017), at p. 44.
[231] Thambisetty (2017), at pp. 18-19; Thambisetty (2009), at p. 23.
[232] Thambisetty (2017), at p. 1.

normative standards, their critical scrutiny is rendered difficult.[233] The result is a quasi-legal text not subject to oversight by any other instance but the EPO itself that nevertheless creates legitimate expectations on the patentability and non-patentability of certain types on innovations. Further, the instructions consolidated in the Examination Guidelines influence how patent applicants present their innovations in the claims to match the rhetoric of the Examination Guidelines. Considering the EPO's role as a major European and global patent law office, the influence of the Examination Guidelines is even broader, and the EPO's approaches may even seep into legislative organs and national judicial bodies.[234]

In summary, the patentability criteria under the EPC cannot be reduced to purely legal standards or purely technological considerations.[235] The EPO is able to adapt to technological developments more agilely than the legislator, but is also a powerful policy setter that has the prerogative to interpret the flexible patentability standards of the EPC in a manner that is technology- and industry-specific but not necessarily value neutral, sometimes leading to arbitrarily contradictory decisions.[236]

# 6 CONSIDERATIONS BEYOND CONNOR

## 6.1 THE EPO AS A MAJOR REGIONAL PATENT OFFICE

The requirement of inventive step is substantiated not by the text of the EPC but by the case law created by the Boards of Appeal, the decisions of which are not appealable outside the EPO. However, it may be revisited by national courts in proceedings concerning patent invalidity or infringement. As discussed previously, even though not obligated to do so, in practice, the national patent offices and courts of the EPO member states tend to follow the EPO's interpretation of the EPC's patentability criteria, and the courts are unlikely to invalidate patents granted by the EPO in order to not upset the expectations of commercial actors.[237] It is also noted in the amicus curiae briefs that the application of the Infineon-approach has created valuable consistency with regard to computer simulation patentability.[238] While the Infineon-

[233] Thambisetty (2017), at pp. 20-21.
[234] Thambisetty (2017), at pp. 11-12.
[235] Plomer (2019), at p. 65.
[236] Thambisetty (2009), at p. 8-9; Thambisetty (2017), at p. 44; Plomer (2019), at p. 62.
[237] Plomer (2019), at p. 61.
[238] Amicus curiae brief by CIPA, at p. 1.

approach has found support in the national patent offices and courts, should the EPO radically change its course from the established practices of the Infineon, there is no guarantee that they would automatically follow the new EPO position. This, in turn, might lead to applicants filing their computer simulation related claims in national offices rather than at the EPO.

Such divergence between the EPO and national courts, however, is hardly an intended outcome of the EPC.[239] In their analysis on the inadmissibility of the referral G 3/08, Pila notes a discrepancy between the EBoA emphasising the importance of transparent judicial analysis and consistent decision-making on the one hand, and its failure to take into account, among other things, its central role in the European patent system, including the impact its decisions have on national level.[240] G 3/08 provides an interesting contrast to Connor and G 1/19 in general, as the EBoA expressed a clear preference for the legislator to decide patentability of computer programs by stating that *"-- a presidential referral is not admissible merely because the European Parliament and Council have failed to adopt a directive on CII patenting or because consistent Board rulings are called into question by a vocal lobby -- When judiciary-driven legal development meets its limits, it is time for the legislator to take over"* [241]. Considering that by answering the questions the EBoA could potentially have a positively impacted the uniform application of patent law in Europe, the response seems surprising.

The effects of the EBoA decision may not be limited to Europe. The EPO's patentability standards, when benchmarked against comparable standards of other patent offices, are sometimes considered as "golden standards", the fulfilling of which usually indicates that an invention will also likely be allowable, for example, in Japan, China and the U.S. However, this is not always the case, as some patent offices have a lower bar for CIIs than the EPO.[242] Nevertheless, for example, despite doctrinal differences between the U.S. and Europe around subject-matter eligibility, the European approach being more formal and requiring the existence of an "invention", and the U.S. statute remaining silent as to what does not constitute patentable subject-

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[239] Amicus curiae brief by CIPA, paras. 3.5-6.
[240] Pila (2011), at pp. 225-226.
[241] G 3/08, r. 7.2.7.
[242] Combes, David (2017, Mar 21); Shemtov (2009), at p. 506-514.

matter[243], convergence between the laws, or at least the practice of the United States Court of Appeals for the Federal Circuit (CAFC) and the EPO exists, as the CAFC has expressed a tendency to align its positions with those supported by the EPO. [244]

The European Patent with unitary effect, if and when it has come into being, will be granted by the EPO in the same manner and under same requirements of the EPC as the European patents currently are. Arguably, the EPO would has the potential to be regarded as a premium patent office globally if, and when, the EPO-issued unitary patent and the European Patent Court to implement it have come in to being.[245] This significant in that, considering the influential role the EBoA plays in interpreting the EPC, a situation where computer-implemented simulations were regarded non-patentable by the EPO and patentable by national patent offices or could encourage patent applicant to do "forum shopping" and file applications in national patent offices where the interpretation of the patentability criteria works in their favour. While such forum shopping with regard to filing patent applications, much like with forum shopping in patent litigation cases, does and has always existed to some degree, major divergences in in the interpretation of the patentability criteria at the national- and EPO-levels, could exacerbate this phenomenon. [246] In addition to potentially dampening the usefulness of the unitary patent and the EPO's desirability as a patent office in comparison to national European patent offices, there is no guarantee that other major patent offices globally would decide on the patentability of computer-implemented simulations the same way as the EPO.[247]

## 6.2 DOMINO EFFECT ON OTHER CIIS AND INDUSTRY RESPONSE

The outcome of G 1/19 is regarded as potentially highly impactful in many (at the time of writing this work) recent internet publications by various European patent industry representatives and law practitioners. In general, the opinions expressed reflect uncertainty, predicting that it could have either a rejuvenating or crippling effect on the simulation software market in Europe and either help or hinder companies in the

[243] Thambisetty (2016), at p. 692.
[244] Shemtov (2017), at p. 185.
[245] Plomer (2019), at p. 67.
[246] Sterckx & Cockbain (2010), at p. 371.
[247] See e.g. Ballardini (2008), discussing the remaining differences between the EPO and national practices.

global marketplace.[248] Some even call into question whether the EBoA upholding the decision would imply that the patent system in Europe is fit for purpose for inventions coming from new and growing technology sectors.[249] The case is viewed to have the potential to affect the patentability of CIIs in general as the state-of-the-art method for conducting simulations is through computer-implementation. In addition to various industries increasingly relying on simulations to improve their productivity via, for example, bypassing the need to test their products in the real world, simulation also underlie several technological applications relating to artificial intelligence, machine learning, virtual reality, Internet of Things, to name a few, used in various fields ranging from engineering and manufacturing to medicine, that are not necessarily considered to be "merely" simulation-related innovations on the outset, even though computer-implemented simulations are essential to their functioning.[250] For example, artificial intelligence applications are usually built on computational and mathematical models, which are then simulated and like simulation methods, as a result of which artificial intelligence, too, falls under the category of mathematical methods in the Examination Guidelines.[251]

The fact that the referral has stirred up interest in a variety of specific industries is reflected in the variety of amicus curiae briefs submitted. For example, pharmaceuticals is a salient example of a field where simulation methods in the form of computer-aided drug design have brought improvements to the development of new pharmaceuticals compared to traditional, considerably more expensive and time-consuming methods. With regard to drug research and development, in the brief submitted by the European Federation of Pharmaceutical Industries and Associations (EFPIA), it is noted that *"[d]evelopment of new medicines today frequently relies on computer-implemented modelling and simulation of physical systems, such as biological systems, molecules, and their interactions. -- Modelling and simulation are also frequently used when developing improved production methods or when developing medical devices delivering drugs"*.[252] he significance of the decision is also noted with regard to the closely related fields of bioinformatics and computational

[248] See e.g. Piotrowicz, Pawel (2019, Dec 2); Baker, Anton (2019, Dec 23) and G1/19: Are simulations inventive? (2019, Aug 28).
[249] Piotrowicz, Pawel (2019, Dec 2).
[250] Wingrove, Patrick (2019, Oct 10).
[251] Examination Guidelines, G-II, 3.3.1.
[252] Amicus curiae brief by EFPIA, at p. 2.

biology, concerned with developing methods and software tools for the handling of complex and large amounts of biological data and concerned with questions such as the mathematical modelling of the spreading of infectious diseases to create intervention and prevention strategies.[253]

The technology- and industry-level response to the referral warrant a brief consideration of the EPO's possibilities to employ patent law as an effective policy tool through technology- and industry-specific application. The TBA's ostensible view that the question of the patentability of computer-implemented simulation methods should be treated differently from the question of patentability CIIs in general appears to not fit Burk and Lemley's notion that policy levers (that is, flexible patentability standards) may be either macro-level (expressly treating different industries differently) or micro-level (certain types of inventions receiving different kind of treatment than others regardless of the specific industry but in a manner that disproportionately impacts certain industries more than others) – rather, creating a new approach targeting computer-implemented simulation methods appears to fit both categories at once without producing the hoped outcome of either approach: On the one hand, as computer-implemented simulation methods allow for the convergence of various technologies and industries, the separation would treat different industries without truly taking into consideration their individualised circumstances and special characteristics.[254] On the other, considering the wide applicability of simulation methods across various industries and applications, technology-specific application of the law does not seem to easily lend for the case-by-case, invention-by-invention approach either. It seems that simulation methods acutely demonstrate that the technology-specific application of patent law is not without its troubles.

## 6.3 THE FUTURE IS SIMULATED – VIRTUAL EFFECTS AND INVENTIONS IN THE VIRTUAL

Although it appears that the EBoA will more likely than not reject the requirement for a direct link with physical reality as proposed by the TBA, a number of open question

[253] Terfve, Camille (undated). For definitions of bioinformatics and computational biology, see e.g. the related Wikipedia articles, available at https://en.wikipedia.org/wiki/Bioinformatics and https://en.wikipedia.org/wiki/Computational_biology respectively (last accessed 24.11.2020).
[254] In discussing the benefits of technology-specific application of patent law, Burk and Lemley note the unexpected convergence of seemingly unrelated technologies, such as biotechnology and software as one factor rendering the creation of technology-specific patent law difficult. See Burk & Lemley (2003), at p. 1635.

remain. Should the EBoA conclude that virtual technical effects shall be used in the assessment of computer-implemented simulation methods in the future, how should this virtual effect be ascertained? How specific of an application do patent applicant in their claims to a simulation method present? Taking into account the trend of technologies becoming increasingly intangible, it is not all that certain that the EBoA's answers will bring log-term clarity to the questions presented to it.

Notably, the arguments made during the oral proceedings referred to simulation methods only in the context of engineering, foregoing the opportunity to discuss, for example, the use of simulations in researching the interaction between vaccines and viruses − potentially due to the backgrounds of the representatives of the appellant and the EPO President.[255] Considering the significance of simulation methods in various fields, both in the field of engineering and outside it, it seems more than likely that that the EPO may need revisit these questions soon irrespective of the answers the EBoA will present in the present case. Reassuringly, despite its inherent complexities, the EPO's institutional design in combination with the flexibility of the EPC allows for future evolution of the EPO's position.

Considering the above, it is noteworthy that the Boards of Appeal have already tackled with the question of innovations in the virtual. In decision T 0339/13 (Interacting with virtual pets/IMMERSION)[256] the TBA adopted a "real-world stance" of sorts. In *Immersion*, the patent application concerned a *virtual pet* that could be "any simulated creature or character, which may or may not have a "real-life' counterpart".[257] In other words, the applicant sought to patent human interaction with a pet in a virtual environment. The applicant's claims to a method and an apparatus *"for providing haptic feedback in interacting with virtual pets -- wherein the haptic effect is a pulsing sensation, wherein the rate or magnitude of the pulsing sensation indicates the health state of the virtual pet"* were rejected by the Examining Division. Notably, the TBA viewed that the important interaction took place between a human and a haptic device in the "real" world. In interpreting the appellant's claims, the TBA stated that *"[i]nstead of a virtual electronic pet which the user is not supposed to handle, the board considers that the starting point for the assessment of inventive step must rather*

[255] Parminder, Lally (2020, Jul 15).
[256] T 0339/13 (Interacting with virtual pets/IMMERSION) of 17.11.2015.
[257] T 0339/13 (Immersion), r. 4.

*be a device which the user is supposed to hold"*[258], concluding that the incorporation of haptic feedback in a handheld gaming device was insufficient to establish inventive step. The TBA's attention was then directed to the appellant's claim that the haptic effect was said to enhance the realism of the user's relationship with the virtual pet and to increase the user's engagement with the pet.[259] The TBA viewed that these problems were not technical nor necessarily always solved by the alleged invention: the enhanced engagement would depend on the subjective assessment of a player and it was impossible for the TBA to estimate if the claimed pulsing sensation truly enhanced realism in a quantifiable manner, especially if its purpose is to convey the virtual pet's state of health.[260]

Where the main claim failed to persuade the TBA, an auxiliary request limiting the virtual pet to a cat, the haptic effect to a purr, and the modelled interaction to petting the cat succeeded. The TBA was persuaded that a technical problem solved by the invention was increasing "realism" and, in the context of virtual pets, "achieving the reliable and reproducible perception of a physical interaction with the real pet". This was held to have been solved in a non-obvious manner by technical means, more specifically "a reciprocating cursor movement and haptic feedback". The TBA considered that producing a toy that mimics reality is not a "simulation" in the same sense of this term used in science and engineering. The owner of a toy must be willing to accept the toy's behaviour as real – virtual toys are not different from any other toys in this regard. Less is required for a toy to be perceived as real, or to resemble a real object, than from a simulation in science, manufacturing or system control to achieve its technical purpose.[261]

In the end, the TBA accepted the aim of achieving reliable and reproducible perception of a physical interaction with a real pet as a technical problem in the context of virtual pets. Moreover, the TBA found that if the invention solves this problem with technical means, i.e. through the technical features of the device interface, namely a reciprocating cursor movement and haptic feedback, it could be patentable. In the light of the emerging importance of virtual inventions, could be argued that the TBA's reasoning in Immersion was not without flaws. It has been suggested that the TBA

[258] T 0339/13 (Immersion), r. 12.
[259] T 0339/13 (Immersion), r. 16.
[260] T 0339/13 (Immersion), r. 16.1-3.
[261] T 0339/13 (Immersion), r. 18.2.

failed to see that the true value of the invention in Immersion and the simulated interaction lies in the virtual human interacting with a virtual pet.[262]

What would, then, a patentability standard satisfying the needs of the EPO, the inventors, and the society at large be, in a world of increasingly intangible inventions? Discussion appears fairly scarce. In connection with discussing whether the patent system is beneficial to radical technologies and whether it recognises their radical nature adequately or rather denies it, forcing them to fit old established conventions, Leith maintains that since the early days of the EPO assessing the technical character of CIIs, "the programmer's view of technology" has largely been a missing element: while a programmer views the processing of information as the output of a new innovative technology, the legal requirement of patentability has remained focused on looking for a physical change.[263] The suggestion to equate potential and virtual technical effects of an invention as suggested during the oral proceedings is no entirely unheard of. Bird envisions, in the U.S. context, a "virtual analogy rule" regarding software: If a physical process, machine, manufacture, or composition of matter can be cited, or at least reasonably conjured using imagination, the software standing in the place of these physical machines and processes should be patentable, regardless whether an actual physical machine ever existed or whether such a physical process took actually place. The only limitation would be a requirement for patent applicants to be able to either visualise or articulate in their claims the actual or imagined analogous physical reality, a requirement which patent examiners and courts should strongly enforce.[264] Commentators of the Immersion, too, appear to have put forward a view that the focus should rather be on how objects look in and interact with the virtual world they are created in as opposed to on how virtual objects look and interact in the "real" world.[265]

It could also be argued that the nature of simulations must be construed in an entirely different manner in the context of patent law in order to preserve its incentivising effect. Standards and threshold requirements for patentability, such as inventive step and technical character requirement, have been developed to ensure that patents are not granted to inventions that have little merit. Simulation methods could perhaps be

[262] Lydén, Joacim & Ferrill, Elizabeth D. (2017, Apr 26).
[263] Leith (2007), at pp. 34-38, 193-194.
[264] Bird (2015), at pp. 48-49.
[265] Lydén, Joacim & Ferrill, Elizabeth D. (2017, Apr 26).

regarded as a form of "computerisation of inventions", "transferring of a known process to the internet", as has been argued by Moir in the case of business methods, whose patentability would similarly be an indication of the defectiveness of the inventiveness standard, stemming from how the standard is ultimately a product of the procedures of EPO and its case law.[266] According to Moir, if inventive step was to be construed strictly as a "reasonable contribution to new knowledge or know-how", number of patent applications could drop, but the overall level of innovation would not fall, as only genuine inventions would pass the test with ease − pushing out business methods from the realm of patentability, for example.[267] Similarly, Thambisetty considers the inventive step a "gate-keeping" criterion, which eliminates inventions that would have been invented even in the absence of the patent system.[268] While the views expressed in the amicus curiae briefs, by the EPO President and the appellant during the oral proceedings focused on providing support for the EPO continuing the application of the Infineon-approach, the potential need for redefining the concept of inventiveness did not go entirely unnoticed: Echoing Moir's view, in their amicus curiae brief, Dr. Bakels posits that the paradoxes of the EPO's various approaches to finding technicality could be overcome if inventions were understood as a form of technical knowledge and the attention shifted to the evaluation of the technical character of the knowledge to be patented.[269]

# 7 CONCLUSIONS

## 7.1 SUMMARY OF FINDINGS

To summarise the findings in this work, as discussed in Chapter 2, patent systems have the potential to either help or hinder technological innovation and advancements. Ideally, they allow inventors to reap rewards of the patent system for their innovations in a manner that is proportionate to the level of innovativeness of their inventions. However, the development and advancements in technology often create uncertainty with regard to how existing laws should be applied in new situations or uncertainty about whether they end up having the effects they were originally intended to have. Computer-implemented simulation methods are a case in point: considering the

[266] Moir (2013), at pp. 50, 69.
[267] Moir (2013), at p. 166.
[268] Thambisetty (2009), at p. 8.
[269] Amicus curiae brief by Dr. Reinier D. Bakels, at pp. 4-5.

importance and wide applicability of simulation methods the decision of the EBoA will bring about immense repercussions across technological fields. From Chapter 3 it can be concluded that the EPC sets considerable subject-matter eligibility restrictions for CIIs, but that these exclusions are not categorical. The patentability standards for CIIs have been, in an incremental and gradual manner, created through the EPO case law. It is anticipated that the EBoA will hand down its decision on computer-implemented simulation methods before the end of 2020[270] and, hopefully, its answers may also provide some clarity to the first research question I set out to examine, namely *are computer-implemented simulation methods patentable under the EPC and if so, under what conditions?*

The relief provided by the EBoA's answers, however, may be only temporary. Connor evidences that simulations have the potential to raise new controversies about the patentability of a number of important and emerging simulation-based technologies, and it appears clear that the diminishing link to physical real world in particular is a phenomenon that concerns a large number of industries and technologies and as such is unlikely to become any less meaningful in the future. As the question of link to physical real world appears to have surfaced only in individual cases prior to Connor, without being the central question in any of them, it seems unlikely that we will need to await for the next EBoA decision for more than a decade. Whatever the outcome of the EBoA's decision in the present case, future guidance may be important going forward in patenting inventions in an increasingly virtual world.

In the initial stages of writing this work, my own attention was caught by the uncertainty whether the TBA's referral is a genuine inquiry as to the technicality of computer-implemented simulation methods, or whether it is a patent policy question in the sense that the EPO is deliberately looking into ways to narrow the scope of patentability of simulation-based inventions. As a consequence, my second research question came to be *where does the EPO's current uncertainty how to decide the case of Connor stem from and what does the situation tell us about the EPO's approach to dealing with (disruptive) innovations?* My own assessment on the nature of the TBA's referral is that the answer may be both: On the one hand, as discussed in Chapter 2, the rapid and unpredictable technological developments make it difficult if impossible

[270] Sandys, Amy (2020, 16 July).

to predict what kinds of innovations will dominate our lives and what kinds of patent laws are needed to create a sufficiently favourable environment to govern them. On the other, as discussed in Chapter 3, the Boards of Appeal have clearly demonstrated their willingness to expand limit the patentability of certain types of innovations.

There is perhaps no way to answer the above question with utmost certainty: As discussed in Chapter 5, the complexity of the European patent system and the modality of the EPO's law-making − the curious institutional design of the EPO (a specialised administrative body with quasi-judicial functions), its orientation towards the expectations of patent applicants as opposed to public-domain stakeholders, the "technolaw" quality of patent law, and the feedback-loop created by the Examination Guidelines − render scrutiny of the EPO's decision-making difficult and hide the fact that individual decisions can fundamentally affect patentability requirements and direct European patent policies. Connor highlights that the EPO warrants considerable power in determining the European policies regarding the future of patentability of simulation-based applications and that as applicants will likely take a stance for continued protection for all kinds of simulation applications, the EPO will have to continuously adjust its own position in the midst of various countervailing forces. The issues addressed in Chapter 6 only begin to outline some of the challenges and considerations that may become relevant in the future.

## 7.2 WAYS FORWARD

What would, then, be a reasonable way forward? Adopting the applicant's point of view for a while, the view that any new requirement considerably narrowing down the patentability of computer-implemented simulations could be an erroneous interpretation and have the potential to cause negative outcomes in the future regarding simulation applications seems reasonable. On the contrary, it could be construed as arbitrarily denying their legitimate interest in and upsetting their legitimate expectations for obtaining patent protection for their invention, as it appears to meet all existing patentability criteria. Moreover, such a requirement could potentially leading to the stagnation of innovation in a technological field that the EPO cannot afford to become stagnant or unnecessarily fragmented, possibly paving way away from a balanced patent system. Shifting to the viewpoint of the Boards of Appeal for a while, given that technology evolves at a quicker pace than the legislation governing it, and that physical, mechanical inventions have dominated patents for most of the history,[271] it appears quite understandable that patent laws are tied to the real world we currently live in and that lawmakers, such as the EPO, use the physical reality we live in as a point of departure even when inventions have more to do with the virtual than the "real world". My own assessment is that it is reasonable to conclude that the EPO will continue to attach a degree of significance to some form of real-world physical link in determining the technical character of an invention, although its position may change in the future. The EBoA's eventual decision on the present case, however, may be regarded as a welcome one, having created discussion on the topic.

Neither of the above perspectives, however, accounts for the EPO's willingness to expand, and now potentially to limit, the patentability of certain types of innovations. What appears to be missing from the conversation is how and why the issue of computer-implemented simulation methods has just now come before the EBoA for its assessment. Is a mere mentioning of that the outcome of the referral "is important not just for the present case but for a potentially large number of cases involving computer-implemented simulations" in a referral sufficient? In more general terms, is it sufficient that a decision with potentially broad implications are made in a quasi-jurisdictional process involving a patent applicant, represented by their patent attorney, and the EPO Boards of Appeal? Moreover, patent protection requires the registration of the claimed invention, placing he duty for the patent applicant to identify the invention for which protection is sought for in the patent claims with the necessary level of precision and clarity, for which the EPO should be able to readily provide adequate guidance for. Regardless of the outcome of the referral, it will likely eventually be incorporated into the Examination Guidelines.

Based on the problematic perspectives described by Plomer, Thambisetty, Burk and Lemley and others, ideally, G 1/19 could act as a catalyst for the EBoA to attempt at alleviating some of the identified issues. Echoing the views expressed by Bakels in their amicus curiae brief, I agree that while building on existing case law may in most cases be the best approach, the EBoA building on the Infineon-approach by itself would do nothing to alleviate the underlying problems, such as the existing paradoxes concealed by opaque patent-language and deficiencies in democratic legitimacy in the

[271] Moir (2013), at p. 38.

interpretations of the EPO.[272] Added transparency and the EPO taking stronger ownership of its role as a patent law creator and patent policy setter seem like obvious first-aid remedies that would not impact the EPO's ability to remain flexible in the face of technological developments. Considering that the EPO President, the appellant, some of the amicus curiae briefs submitted and, although very succinctly, the TBA, alluded to the increasing importance of computer-implemented simulation methods to numerous industries and technologies and consequently to the European economy, it would be appropriate for the EBoA to in its decision to articulate if and how such considerations affected its decision, to ensure both the predictability of the EPO practice and its legitimacy. Whether the EBoA will do so remains to be seen. Personally, I am of the opinion that, considering the strong case the EPO President's representatives and the appellant made for equating potential technical effects with virtual technical effects and the obvious growing significance computer-implemented simulation methods have, the EBoA's answer would not be complete without them. Similarly, an outcome where the EBoA deemed the question inadmissible as it did in G 3/08 would be disappointing.

Second, going further, although the discussions during the oral proceedings and the amicus curiae briefs denote the importance of industry- and technology-specific considerations and the inclusion of various stakeholders in Connor, it may be crucial for the EPO to ensure that as a similar minimum level of inclusion of different kind of stakeholders, such as civil society organisation, economists and experts on the particular technical field in question, is practiced to ensure that the state-of -the-art of the technology in question is discussed as widely as possible in general.[273] As decisions of the patentability or scope of patent protection for new technologies and their applications is unavoidable, it may be worthwhile to ask if there be another arena to discuss these matters more widely outside appeal proceedings. While it is an inherent part of the EPO's work, the dilemma persists: guiding the EPO's decision-making through more detailed legislation would likely be ineffective, as said legislation would likely be rendered obsolete by unanticipated developments in the technology; hence a level of flexibility and discretion is necessary.[274] Greater

[272] Amicus curiae brief by Dr. Reinier D. Bakels, at p. 7.
[273] Schneider (2009), at pp. 624-625. In discussing the EPO governance issue from the perspective of the Biotech Directive and the scope of patentability of DNA sequences, Schneider recommends stronger initiative on the EPO's behalf to involve human geneticists and civil society organisations.
[274] Schneider (2009), at pp. 626-627.

transparency and understanding how legal problems arise during technological change allows legislators and courts alike to have foresight about the potential new issues and, conversely, also not to exaggerate them unnecessarily.

To finally conclude this work, I feel it is worth noting that during the oral proceedings of Connor, the EBoA decision G 2/07 and the EBoA's notion of what constitutes the "core" of an invention, i.e. what can be understood without a doubt to fall within the notion of an invention, were discussed.[275] It was emphasised that whatever is identified as the core of an invention at a given time does not limit what the scope of an invention can hold and that the notion of technology in the EPC should not be a static one but one that evolves alongside actual technological developments. An understanding of technology whereby a direct link to physical reality in the sense of a measurement or a change in a physical entity is certainly at odds with contemporary technological developments, heavily characterised by digitalisation and virtualisation of technical problems. Hence, to finally conclude this work, I feel that including the following two citations would be most fitting: In 1943, Thomas Watson, the then-president of IBM, allegedly speculated that there would be "a world market for maybe five computers"[276], a prediction that has since proven to be spectacularly wrong and one that did not quite manage to capture the extent computers would fundamentally come to change the world. In 2005, U.K. judge Peter Prescott stated that *"[w]e sense that we know 'technology' when we see it"* − certainly true most of the time, but deceptively so whenever there is an attempt to define "technology" in manner that can be agreed on by everybody.[277] The fact that technology is constantly evolving and the need for flexibility is recognised in the EPC, deliberately refraining from giving a legal definition of "technology". The focal point of this paper, the case of Connor, illustrates that our definitions of "technology" and "technical effect", fundamental in ensuring that the patent system functions as intended, need to evolve and be taken carefully into consideration as simulations methods continue to develop into unforeseen directions – our intuition only cannot guide this.

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[275] G 2/07 (Broccoli/PLANT BIOSCIENCE) of 9.12.2010. Also referred to by the TBA in T 0489/14 (Connor), r. 11.

[276] Wikipedia article on Thomas J. Watson, available at https://en.wikipedia.org/wiki/Thomas_J._Watson (last accessed 24.11.2020).

[277] CFPH LLC v Comptroller-General of Patents, Designs and Trade Marks [2005] EWHC 1589 (Pat), 21.7.2005. As reported by Phillips, Jeremy (22 Jul, 2005): Peter Prescott Rules on the Margins of Uncertainty. *The IPKat.* Retrieved from https://ipkitten.blogspot.com/2005/07/peter-prescott-rules-on-margins-of.html (last accessed 24.11.2020).