G 1/19 – COMMENTS BY THE PRESIDENT OF THE EPO

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II INTRODUCTION

1. In opinion G 3/08, the Enlarged Board of Appeal held that although T 424/03 *MICROSOFT* deviated from T 1173/97 *IBM* it represented a legitimate development of case law[1]. Especially since G 3/08, the EPO has steadily and solidly based its practice regarding computer-implemented inventions (CII) on the case law of the boards of appeal. Any further developments in case law have been taken into account and are reflected in the Guidelines for Examination in the EPO. The stability and predictability of the practice of the EPO is of high importance for the users of the European patent system.

2. The basis for the patentability of CII is Article 52(1) EPC. This provision lays down the principle that inventions in all fields of technology are generally entitled to patent protection, provided they are new, involve an inventive step and are susceptible of industrial application[2]. Although Article 52(1) EPC refers to "technology", the legislator deliberately chose to refrain from defining "technology" or "technical" more concretely. This choice was made in order not to preclude adequate protection for the results of future developments in fields of research which the legislator could not foresee[3]. Instead of positively defining the terms "technology" and "technical", Article 52(2) EPC enumerates typical non-inventions, *inter alia* mathematical methods, mental acts, business methods, and computer programs. Their common denominator is a substantial lack of technical character[4]. An overly broad interpretation of Article 52(2) EPC is barred by Article 52(3) EPC. This provision excludes non-inventions from patentability only to the extent that they are claimed "as such"[5]. The formulation of the EPC ultimately derives from the classical notion of invention, which distinguishes practical scientific applications from intellectual achievements in general[6].

3. The case law of the boards of appeal has developed a well-established understanding of these requirements in the context of assessing patentability of CII. That understanding is followed in the practice of the EPO search, examining and opposition divisions, as reflected in the Guidelines for Examination in the EPO[7].

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[1] G 3/08, headnotes points 4-6.
[2] In line with Article 27(1) TRIPS, see CA/ PL 6/99 point 17; Steinbrener in Singer/Stauder, EPÜ, 7th edn (Carl Heymanns Verlag 2016), Art 52 Rn 3 - 4; Justine Pila, *On the European Requirement for an Invention*, IIC 2010, 906, 919.
[3] G 2/07, reasons 6.4.2.1; T 533/09, reasons 7.2. From the *travaux préparatoires* to Article 52 EPC, see MR/2/00, page 43; IV/2767/61-E, pages 4ss; T 489/14 reasons 16.
[4] See Melullis in Benkard, EPÜ, 3rd edn (CH Beck 2019), Art 52 Rn 218ss; Steinbrener in Singer/Stauder, EPÜ, 7th edn (Carl Heymanns Verlag 2016), Art 52 Rn 3 - 4; Derk Visser, Laurence Lai, Peter de Lange, Kaisa Suominen, *Visser's annotated European Patent Convention* (Wolters Kluwer 2018), 59.
[5] See also G 2/12 *Tomatoes II*, reasons 3(b); T 1173/97 *IBM*, reasons 4.1; T 154/04 *DUNS*, reasons 6 with further references to *travaux préparatoires*; M. van Empel, *The granting of European patents* (A.W. Sijthof-Leyden 1975), 31; Söldenwagner in Benkard, EPÜ, 3rd edn (CH Beck 2019), Art 56 Rn 176; Gert Kolle, *The Patentable Invention in the European Patent Convention*, IIC 1974, 140, 154. Whether a particular subject-matter is excluded from patentability is decided without taking into account prior art, see G 2/07, reasons 6.4.1.
[6] See T 154/04 *DUNS*, reasons 8.
[7] Guidelines for Examination in the EPO, 2018, see e.g. G-II, 3, G-VII, 5.4.

4. The examination as to whether claimed subject-matter is an invention in the sense of Article 52(1) EPC is performed by applying the "any technical means"[8] approach established by T 258/03 *HITACHI*. Technical character is acknowledged for all claimed subject-matter requiring the use of any technical means. Having technical character is furthermore considered to be a sufficient condition for claimed subject-matter to qualify as an invention. It follows that computer-implemented methods are inventions in the sense of Article 52(1) EPC by virtue of requiring the use of a computer[9].

5. The "any technical means" approach does not imply, however, that any computer-implemented method is granted patent protection. The CII must involve an inventive step within the meaning of Article 56 EPC. The Comvik approach, established by T 641/00 *COMVIK*, assesses inventive step by considering only those differences with regard to the closest prior art which contribute to the technical character of the invention.[10] Hence, all features are taken into account that contribute to solving alone or in combination a technical problem, i.e. a problem in a field recognised as technical.[11]

6. With interlocutory decision T 489/14[12] dated 22.02.2019, Board of Appeal 3.5.07 referred questions relating to the assessment of inventive step of computer-implemented simulations to the Enlarged Board of Appeal[13].

7. The application underlying the referring decision relates to a computer-implemented method for simulating movement of a pedestrian crowd through a modelled environment or building structure. The main purpose of this computer-implemented simulation is to provide results which can be used in a process for designing buildings such as railway stations or stadiums. The designer specifies the parameters of a pedestrian crowd typical for the designed building and performs a number of simulations of pedestrian flows. The design can then be revised, if necessary, depending on the simulation results obtained.[14]

8. The referring board considers that the “environments” to which the claim is limited, when they exist in physical reality, are technical, and that the rate at which pedestrians can pass through such an environment is a technical property of the environment[15]. The simulated environment or building may however be entirely virtual and never exist in physical reality. In the light of these circumstances, the board seeks clarification as to whether computer-implemented simulations of technical systems of processes, or design processes involving such simulations, can be considered to solve a technical problem, and, if so, under which conditions.

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[8] The term "any technical means" has been used in G 3/08, reasons 10.6 and in G 2/07, reasons 6.3. This approach established in T 258/03 *HITACHI* is also referred to as the “any hardware” approach; see G 3/08, reasons 10.6.
[9] T 258/03 *HITACHI*, headnote I.
[10] T 641/00 *COMVIK*, reasons 4-6.
[11] T 641/00 *COMVIK;* T 154/04 *DUNS.*
[12] Based on application EP 03 793 825.5.
[13] See the Official Journal of the EPO 2019, A50.
[14] T 489/14, reasons 2.
[15] T 489/14, reasons 14.

9. In particular, the board puts forward the following three questions:

(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?

10. In its analysis of inventive step, the referring board considers that the presence of a technical effect requires at least a direct link to physical reality, such as a change in or a measurement of a physical entity. As such direct links are absent from computer-implemented simulations of technical systems or processes claimed "as such"[16], the board holds that they do not solve a technical problem going beyond the computer-implementation[17].

11. With its reasoning, the referring board disagrees with T 1227/05 *INFINEON*. The teaching of that decision is that the computer-implemented simulation of an adequately defined class of technical items, such as an electronic circuit subject to 1/f noise, serves a technical purpose and constitutes in itself a technical effect[18]. The referring board states that the reasons for divergence are twofold: First, computer-implemented simulations merely assist engineers in the cognitive process of verifying designs. Such a cognitive process, however, is fundamentally non-technical. Second, T 1227/05 *INFINEON* seems to base its acknowledgment of technical effect on the greater speed of the computer-implemented method. This criterion seems for the referring board to be irrelevant in view of pertinent case law[19].

12. In the light of the EPO's current practice and the case law of the boards of appeal[20], it seems that a broad application of the referring board's suggested approach would have an impact on the patentability of computer-implemented simulations of technical systems and processes. It could also have an impact

[16] The expression "claimed as such" used in the first and second referral questions is understood as referring to claims not including steps preceding the simulation (e.g. relating to measurements being made to construct the model underlying the simulation) or following the simulation (e.g. relating to a particular use of the simulation results); see T 489/14, reasons 11 and 23, and the formulation of the third referral question.
[17] T 489/14, reasons 11.
[18] T 1227/05 *INFINEON*, reasons 3.1, 3.1.1, 3.3.
[19] T 489/14, reasons 15ss.
[20] See the 2018 edition of the Guidelines for Examination in the EPO G-II 3.3.2 and decisions cited therein.

on computer-implemented inventions in a large variety of other technical fields[21].

13. At the same time, the referral provides an opportunity for guidance by the Enlarged Board of Appeal on the assessment of inventive step of computer-implemented simulations. Development of the law is an essential aspect of its application, whatever method of interpretation is applied, and is therefore inherent in all judicial activity[22].

III THE FIRST REFERRAL QUESTION

14. The first referral question seeks to clarify whether, in the assessment of inventive step, the computer-implemented simulation of a technical system or process[23] can 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.

15. Following the "any technical means" approach[24], any computer-implemented simulation method constitutes an invention in the sense of the EPC by virtue of requiring the use of a computer. Therefore, assessing the patentability of computer-implemented simulations focuses on the requirements of novelty and inventive step[25].

16. The question of inventive step is addressed by applying the well-established problem-solution approach. This approach involves examining whether the invention solves a technical problem over the closest prior art in a non-obvious way. A solution to a technical problem, in turn, relies on the presence of a technical effect. While the EPC does not mention the term "technical effect", this interpretation of Article 56 EPC is broadly supported by the case law of the boards of appeal[26].

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[21] See the 2018 edition of the Guidelines for Examination in the EPO, G-II, 3.3, for a number of examples. Some inventions in technical fields such as computer graphics, speech synthesis, or cryptography could be found not to involve a direct link to physical reality in the sense of a change in or a measurement of a physical entity (see, for instance, the method for generating cryptographic keys in T 1326/06). Similarly, in other technical fields such as telecommunications, data compression or image processing, inventions often merely concern computer-processing of representations of physical entities without a direct link to physical reality.

[22] G 3/08 headnotes point 6.

[23] The reference to a "technical system or process" in the question excludes from its scope simulations of non-technical systems or processes. Examples would be the simulation of a financial market but also the simulation of exclusively natural phenomena (e.g. movement of planets). Such simulations would have to be assessed in view of the exclusion from patentability of scientific theories as such (Article 52(2)(a),(3) EPC).

[24] See point 4 supra.

[25] See also Melullis in Benkard, EPÜ, 3rd edn (CH Beck 2019), Art. 52 Rn 65; Andreas Wiebe und Roman, Heidinger, *Ende der Technizitätsdebatte zu programmbezogenen Lehren? - Anmerkungen zur EPA-Entscheidung „Auktionsverfahren/Hitachi"*, GRUR 2006, 177, 179; Rudolf Kraßer, *Erweiterung des patentrechtlichen Erfindungsbegriffs?*, GRUR 2001, 959, 960.

[26] T 931/95; T 935/97; T 1173/97 *IBM*; T 641/00 *COMVIK;* T 914/02*;* T 258/03 *HITACHI;* T 154/04 *DUNS*; Melullis in Benkard, EPÜ, 3rd edn (CH Beck 2019), Art 52 Rn 67 with further references; Söldenwagner in Benkard, EPÜ, 3rd edn (CH Beck 2019), Art 56 Rn 178; Kroher in Singer/Stauder, EPÜ, 7th edn (Carl Heymanns Verlag 2016), Art 56 Rn 54; Derk Visser, Laurence Lai, Peter de

17. In order to address the first question posed by the referring board, the principles guiding the assessment of inventive step of computer-implemented simulations according to the problem-solution approach are discussed below, taking into account the specific requirements for assessing mixed-type inventions. It is considered that the application of the problem-solution approach allows for answering the first referral question. To complete the picture the requirement of a direct link to physical reality considered by the referring board will be addressed separately.

III.A Inventive step of mixed-type inventions

18. As noted by the referring board, if a method claim encompasses a purely mental realisation of all method steps, it falls into the category of methods for performing mental acts as such (Article 52(2)(c),(3) EPC). This applies regardless of whether the claim also encompasses technical embodiments and whether the method is based on technical considerations[27]. In the context of the assessment of inventive step, the referring board considers that the claimed simulation steps are per se non-technical features because they could, in principle, be performed exclusively mentally.[28]

19. In order to take this point of view into account, the following analysis of inventive step will treat claims to computer-implemented simulation methods as comprising both technical and non-technical features, i.e. as "mixed-type inventions"[29].

20. The problem-solution approach adapted for mixed-type inventions was first outlined in T 641/00 *COMVIK*, later summarised in T 154/04 *DUNS,* and has become established case law[30] which is followed by the EPO in examination and opposition[31]. It assesses the inventive step of such inventions by taking account of all features which contribute to the technical character; features making no such contribution cannot support the presence of inventive step. Non-technical features, to the extent that they do not interact with the technical subject matter of the claim for solving a technical problem, do not provide a contribution to the technical character of the claimed invention and are thus ignored in assessing inventive step. *A contrario*, non-technical features which do interact with the technical subject-matter of the claim for solving a technical problem must be taken into account[32].

Lange, Kaisa Suominen, *Visser's annotated European Patent Convention* (Wolters Kluwer 2018), 125.

[27] See the 2018 edition of the Guidelines for Examination in the EPO, G-II 3.5.1 and the board of appeal decisions cited therein, T 914/02, T 471/05, G 3/08.

[28] T 489/14, reasons 4-5.

[29] See the 2018 edition of the Guidelines for Examination in the EPO, G-VII 5.4.

[30] G 3/08, reasons 10.13.1 - 10.13.2; Söldenwagner in Benkard, EPÜ, 3rd edn (CH Beck 2019), Art. 56 Rn 178; Herbert Zech, *Aktuelle Entwicklungen des europäischen Patentrechts*, EuZW 2018, 437, 438.

[31] See the 2018 edition of the Guidelines for Examination in the EPO, G-VII 5.4.

[32] See T 154/04 *DUNS*, reasons 5, principle (F) and reasons 13.; see also the 2018 edition of the Guidelines for Examination in the EPO, G-II, 3 and sub-sections, in particular G-II, 3.5.3 "Schemes, rules and methods for doing business".

III.B Problem-solution approach – the formulation of the objective technical problem

21. The first referral question enquires whether a technical problem is solved going beyond the simulation's computer-implementation. Following the referring board's indications[33], it is assumed that "computer-implemented" implies in case of simulation that the steps of the simulation as such are carried out by the computer[34]. The computer-implementation may be assumed to be a straightforward implementation of the simulation steps on a general-purpose computer[35].

22. The first question may thus be addressed by starting from a general-purpose computer as closest prior art. It has to be established which objective technical problem a computer-implemented simulation of a technical system or process claimed as such may be considered to solve over this prior art[36].

23. In general, the formulation of the objective technical problem to be solved starting from the closest prior art should not contain pointers to the solution or even partially anticipate it[37]. However, the fact that a feature appears in the claim does not automatically exclude that feature from appearing in the technical problem. According to the Comvik approach, where the claim refers to an aim to be achieved in a non-technical field, this aim may legitimately appear in the formulation of the objective technical problem as a non-technical constraint which has to be met[38]. This has the following effect: Non-technical aspects of the claimed invention, which generally relate to non-patentable desiderata, ideas and concepts, and belong to the phase preceding any invention, are removed from the assessment of inventive step and cannot be mistaken for technical features positively contributing to inventive step[39]. The underlying fiction is that these non-technical aspects are assumed to be given, as a constraint to be met, by a notional non-technically skilled person to the notional "person skilled in the art", who is a person skilled in a technical field[40].

24. When non-technical method steps carried out by a computer reflect technical considerations[41] aimed at ensuring that the method serves a technical purpose, such considerations can only originate from a person skilled in a technical field. It appears to be incompatible with the gist of the Comvik approach to assume that these considerations are given by a non-technically skilled person to the

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[33] See T 489/14, reasons 8 and 21.

[34] As opposed to steps carried out by a user on a computer, such as the additional design steps considered in the third referral question. See T 489/14, reasons 26: the step of revising the model in claim 1 of the 4th auxiliary request may be performed by a human designer operating a CAD program.

[35] See T 489/14, reasons 8 and 20.

[36] The referring board formulates the question in terms of a technical effect (see T 489/14, reasons 20) but also acknowledges that bringing about a technical effect is equivalent to solving a technical problem (see T 489/14, reasons 7).

[37] See the 2018 edition of the Guidelines for Examination in the EPO, G-VII, 5.2.

[38] See the 2018 edition of the Guidelines for Examination in the EPO, G-VII, 5.2.

[39] See T 154/04 *DUNS*, reasons 16.

[40] T 1463/11, reasons 13, T 641/00 *COMVIK*, reasons 5 and 8.

[41] Both mathematical methods and methods to perform mental acts have the capacity to be based on technical considerations.

person skilled in a technical field as a constraint to be met. Hence, it appears that, in such a case, the technical problem cannot simply be framed as "How to implement the non-technical method steps on a computer?"[42] Doing so would amount to an *ex-post facto* analysis which is only possible with hindsight knowledge of the *technical* considerations reflected in these steps[43].

25. As noted in T 817/16 *GOOGLE*, a useful test for determining whether technical considerations are present is to ask whether the non-technical features would have been formulated by a technically skilled person rather than by a non-technically skilled person. This is not an enquiry into the actual state of technical or non-technical knowledge at the effective filing date. The question is rather whether the knowledge required for coming up with the non-technical features in the particular case is of a kind that only a technically skilled person (i.e. a person not working exclusively in areas falling under Article 52(2) EPC) could possess[44].

26. In this context it is noted not all technical considerations suffice to convey technical character to a computer program. This applies in particular to technical considerations which are common to all computer programs.[45] The Enlarged Board of Appeal in G 3/08 suggested, in analogy to the concept of a "further technical effect"[46], that the technical character of a computer program is guaranteed only if writing the program required "further technical considerations"[47]. If non-technical method steps carried out by a computer reflect technical considerations aimed at ensuring that the method serves a technical purpose, such technical considerations are "further technical considerations" in the sense of G 3/08.

27. Accordingly, when applying the problem-solution approach, the objective technical problem to be solved starting from a general-purpose computer, as in the case underlying the referral, should not contain pointers to technical considerations which are reflected in the steps carried out by the computer and which aim at ensuring that the method serves a technical purpose.

III.C Problem-solution approach – the technical problem solved by a computer-implemented simulation

28. To illustrate the approach described above to a claim directed to a computer-implemented simulation, the case underlying T 1227/05 *INFINEON* is taken as

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[42] As is common for computer-implemented business methods. Normally, a business method has in itself no technical character and is not used to solve any technical problem. It is thus disregarded when assessing inventive step. The only technical problem solved by a computer-implemented business method is "How to implement the business method steps on a computer?", i.e. to provide an automation of that business method. If the automation is per se straightforward, the computer-implemented business method does not involve an inventive step; see the 2018 edition of the Guidelines for Examination in the EPO, G-II, 3.5.3 "Schemes, rules and methods for doing business".

[43] See the 2018 edition of the Guidelines for Examination in the EPO, G-VII, 5.2.

[44] T 817/16 *GOOGLE*, reasons 3.11, 3.12

[45] Meaning considerations which are required for the construction of any procedure that a machine can carry out.

[46] See T 1173/97 *IBM*, headnote.

[47] See G 3/08, reasons 13.5.1.

an example. It concerns a computer-implemented simulation of the operation of an electronic circuit subject to 1/f noise, hence a technical process. The claimed simulation steps reflect technical principles underlying the simulated process[48]. The design of these steps aims at ensuring that the resulting simulation will provide a realistic prediction of the performance of the designed circuit[49] and thus be technically significant. This design requires the technical knowledge of a person skilled in the technical field of electronic engineering[50]. In view of the above explanation of the problem-solution approach for mixed-type inventions[51], the claimed steps cannot therefore be included in the formulation of the technical problem.

29. It follows that a formulation of the objective technical problem as "How to implement the simulation method on a computer?", as is common for computer-implemented business methods[52], is not possible[53]. As pointers to the claimed method steps must be avoided, the objective technical problem solved, starting from a general-purpose computer, must thus be formulated on the basis of the result of these steps: "How to simulate, with a computer, the operation of an electronic circuit subject to 1/f noise?" This problem calls for the development of a computer-implemented method in the technical field of electronic engineering and is a typical problem a skilled person in this field might be asked to solve. The result of the claimed method steps, i.e. the simulation of the operation of an electronic circuit subject to 1/f noise, is thus the technical effect. This technical effect goes beyond the simulation's computer-implementation[54].

30. A computer-implemented simulation in the sense of the referral is a method producing an *approximate imitation* of the operation of a system or process, on the basis of a model of that system or process. The simulation thereby allows the functioning of the system or process to be assessed or predicted[55]. Simulations concerning technical systems or processes which reflect at least in part technical principles underlying them, provide an approximate imitation of technical aspects of the simulated operation and thus give information about *technical properties* of the simulated system or process.

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[48] The claimed steps relate to the generation of 1/f-distributed random numbers and to their use in a mathematical model of an electronic circuit. This model, the particular type of random numbers used to simulate the noise and the algorithm used to generate these numbers are based on technical considerations: they rely on an understanding of the operation of electronic circuits and of properties of physical noise typical for such circuits.

[49] T 1227/05 *INFINEON*, reasons 3.1.2 and 3.2.2.

[50] T 1227/05 *INFINEON,* reasons 3.1.2.

[51] See section III.B supra.

[52] See footnote 42 supra.

[53] It is noted that if this would have been the valid objective technical problem formulation, the computer-implemented simulation would not have been considered to solve a technical problem by producing a technical effect *going beyond the simulation's computer-implementation*, as required in the first referral question.

[54] The conclusion reached here would be the same as the one reached by the board in the decision T 1227/05 *INFINEON,* albeit based on a different reasoning, see T 1227/05 *INFINEON,* reasons 3.3.

[55] See T 489/14, reasons 11 and 21. The term "simulation" as used by the referring board in the questions is limited to such kind of methods. It does not encompass methods for assessing or predicting the functioning of a system using a model in other ways, such as using a theoretical formula to directly predict a future state of the system without actually (approximately) imitating its operation.

31. Providing such technical information is a technically significant result, as found in T 625/11 *AREVA*[56]. It can be derived from this decision that the computer-implemented determination of a technical parameter which is intrinsically linked to the functioning of a designed technical object serves a technical purpose where the determination is based on technical considerations[57]. Both in T 625/11 *AREVA* and in T 1227/05 *INFINEON,* the information is not obtained by performing mental acts in the sense of Article 52(2)(c) EPC but by way of an *experiment relying on technical principles*: replicating on a computer the operation of the technical system or process under certain conditions implied by the model and its parameters. Obtaining the technical information in such a manner appears to be fundamentally different from how a human being would or even could proceed to obtain that information by mental acts only. It also goes beyond considerations inherent to computer programming as it relies on technical considerations pertaining to the technical field relating to the simulated technical system or process. Where the simulation method reflects, at least in part, technical principles underlying the simulated system or process, it may be considered to be based on "further technical considerations" in the sense of G 3/08[58]. This conclusion applies irrespective of whether the simulation may be used to assist a cognitive process[59].

32. Following the same analysis as developed above for the claim in T 1227/05 *INFINEON* [60], the provision of the simulation results represents a technical effect going beyond the computer-implementation at least to the extent that it is based on technical principles reflected in the simulation steps.

33. The jurisprudence of the EPO boards of appeal to date accepts that a technical effect may reside in providing technical information and it does not need to be a tangible physical effect[61]. Thus, it does not appear to be necessary that the

[56] T 625/11 *AREVA*, reasons 8.4, from which it can be derived that the computer-implemented determination of a technical parameter which is intrinsically linked to the functioning of a designed technical object, where the determination is based on technical considerations, is a technical purpose. In this decision, the board explicitly endorsed the analysis in T 1227/05 *INFINEON*.

[57] T 625/11 *AREVA*, reasons 8.4.

[58] G 3/08, reasons 13.5.1.

[59] Since the technical effect of a simulation is a direct technical effect, not a potential one depending on a potential use of the simulation results, it is irrelevant whether the simulation is used to assist a cognitive process or for another purpose.

[60] It is generally assumed in these comments that the claims considered in the questions are *clearly* directed to a computer-implemented simulation, i.e. that the claimed steps serve the purpose of simulation. In contrast, a claim to a method which would merely refer to the purpose of simulation without being functionally limited to it would not be clear (Article 84 EPC); see T 953/94, reasons 5, and T 1227/05 *INFINEON*, reasons 3.1.2.

[61] As is usually the case in so-called "working methods". See, for instance, T 619/02 *QUEST INTERNATIONAL*, reasons 2.4.1, T 1001/99, reasons 3.3, and T 1586/09, reasons 6. Further, in the very recent decision T 1924/17 (of 29 July 2019) Board 3.5.07 reviews the case law with respect to mathematical methods and the legislative history of Art. 52(2)(a) and (3) EPC (reasons 12, 16 – 19). The Board concludes – in the context of computer-implemented inventions – that mathematical methods *applied to solve a technical problem* have to be taken into account when assessing inventive step. No further conditions appear to be required, in particular not the provision of a tangible technical effect.

technical information provided by the simulation[62] be derived from real-world measurements.

34. It can be concluded that a computer-implemented simulation of a technical system or process claimed as such solves a technical problem by producing a technical effect going beyond the computer-implementation when it reflects, at least in part, technical principles underlying the simulated system or process.

35. The above findings show that a direct link to physical reality, such as a change in or a measurement of a physical entity, as considered by the referring board[63], is not necessarily required for the finding of a technical effect going beyond the computer-implementation in the context of inventive step. In particular the established jurisprudence of the EPO boards of appeal relating to image processing and design methods[64] has to date not required the presence of a direct link to physical reality for the finding of such a technical effect.

36. In the area of image processing, decision T 208/84 *VICOM* accepted that processing of computer-generated images not representing any real-world physical object is technical[65].

37. In the field of design methods, the boards of appeal have found these methods or systems to be technical even though a direct link to physical reality going beyond computer-implementation[66] did not appear to be involved. This line of case law illustrates how technological development can be patent protected by applying the fundamental principles of the patent system. Important in this context is the accepted narrow interpretation of the exclusion from patentability and the agreed understanding that the concept of technicality has not been defined by the legislator in order to allow for patents to be granted for inventions in all fields of technology irrespective of the direction and scope of further technological developments[67].

38. Though the decision T 1173/97 *IBM* has referred, in relation to computer program products, to effects that "only show in physical reality" when the program is being run on a computer[68], it appears that "showing in physical reality" merely means in that context that the effect is actually produced when the computer is run[69]. The effects produced by a computer-implemented *method*, e.g. the simulation of a technical system or process, are also manifested in physical reality in that sense.

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[62] See point 31 supra.

[63] See T 489/14, reasons 11. The referring board did not see such a direct link in computer-implemented simulations claimed as such, in particular not in the simulations underlying the referring decision and T 1227/05 *INFINEON, see* T 489/14, reasons 10 and 11.

[64] See footnotes 65 and 66 infra.

[65] The images considered in T 208/84 *VICOM* could be of "a simulated object (as in computer-aided design/computer-aided manufacturing (CAD/CAM) systems)", see T 208/84 *VICOM*, reasons 3 and *infra;* see also T 605/93, reasons 5.8. Moreover, the filtering operation realised by the claimed method in *VICOM* may serve the purpose of "enhancing" the image, which is compatible with having computer-generated images as input, see T 208/84 *VICOM*, reasons 3.

[66] T 605/93, T 473/98, T 471/05, T 1820/06, T 887/07, T 1909/08.

[67] See point 2 supra, with further references.

[68] T 1173/97 *IBM,* reasons 9.4.

[69] As opposed to the mere possibility of achieving the effect when the computer program is not run.

39. It might be further considered that the case law of the EPO boards of appeal and national courts, for example in Germany, as a rule regards the generation of information on technical properties of a technical system or process derived by computer-analysis of actual measurements of the system or process as technical effects relevant for inventive step, regardless of their subsequent use[70]. Although this point of view was acknowledged by the referring board, it did not consider the generation of similar technical information by computer-implemented simulation to be a technical effect as the generation would in such a case not involve any real-world measurements[71].

40. In this respect, one may consider that any simulation of a technical system or process requires a model suitable for that purpose, such as the one used in T 1227/05 *INFINEON*[72]. The task of constructing a model is typically a cognitive one, albeit one requiring technical knowledge about the simulated technical system or process. In addition to being based, for instance, on laws of physics applicable to the technical system or process, the model may typically also need to be calibrated with technically meaningful values to be suitable for a realistic simulation. These values will ultimately be derived from measurements of related real-world technical systems or processes. Thus, basing the model on real-world measurements allows attributing technical character on the simulation using this model, irrespective of whether the claim includes the measurement steps or whether it is directed to the simulation as such.

III.D The answer to the first referral question

41. The reasoning in sections III.A to III.C above allows for the conclusion that a computer-implemented simulation of a technical system or process claimed as such solves a technical problem by producing a technical effect which goes beyond the simulation's implementation on a computer when the claimed simulation method reflects, at least in part, technical principles underlying the simulated system or process, as e.g. the claim in T 1227/05 *INFINEON*. Hence, the first referral question can be answered in the affirmative.

IV THE SECOND REFERRAL QUESTION

42. The second referral question asks for guidance on the relevant criteria for assessing whether a computer-implemented simulation claimed as such solves a technical problem, and whether it is a sufficient condition that the simulation be based, at least in part, on technical principles underlying the simulated system or process.

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[70] See, for example, T 1670/07, reasons 13; T 1586/09, reasons 6; T 1086/11, reasons 4.2. In Germany, see the decision of the Federal Court of Justice BGH, X ZB 1/15 - *Flugzeugzustand*, headnotes a) to c).

[71] See T 489/14, reasons 11: "*measurement of a physical entity*", reasons 32: "*technical processes carried out on a physical entity and effecting a certain change in that entity*", and reasons 33.

[72] Cf. T 1227/05 *INFINEON,* facts and submissions III.

43. The reasoning provided above for the first referral question leads to the conclusion that it is a *sufficient condition* that the simulation method reflects[73], at least in part, technical principles underlying the simulated system or process.

44. It is noted that the condition enounced in T 1227/05 *INFINEON* is that the claim is functionally limited to the simulation of "an adequately defined class of technical items"[74]. It appears that this condition would normally be fulfilled if the condition proposed above in these comments is met[75]. Conversely, it appears that if a claimed method is functionally limited to the simulation of an adequately defined class of technical items, its steps would normally have to reflect, at least in part, technical principles underlying the simulated system or process[76]

45. The second referral question could thus be answered as follows: A sufficient condition for a computer implemented simulation of a technical system or process claimed as such to solve a technical problem going beyond the simulation's implementation on a computer is that the simulation method reflects, at least in part, technical principles underlying the simulated system or process.

V THE THIRD REFERRAL QUESTION

46. With the third referral question, the referring board seeks clarification about 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.

47. In view of the answers proposed in these comments to the first and second questions, the third question does not appear to require a separate answer. Accordingly, if a simulation reflects, at least in part, technical principles underlying the simulated system or process, it solves a technical problem beyond the simulation's implementation on a computer, irrespective of whether it is claimed as part of a design process.

VI NATIONAL JURISPRUDENCE

48. As noted by the referring board[77], similar issues have been the subject of judicial decisions in some of the EPC contracting states. In particular, the UK

[73] It is noted that the referring board appears to have used the formulation "based on technical principles" as a synonym for "reflects technical principles", see T 489/14, reasons 23, last paragraph.

[74] "eine hinreichend bestimmte Klasse von technischen Gegenständen", see T 1227/05 *INFINEON*, reasons 3.1.1, as noted by the referring board in T 489/14, reasons 13 and 23.

[75] A simulation method which is not limited to an adequately defined class of technical items, but is claimed as being applicable to any technical item, would have to be formulated at such a level of abstraction that its steps could no longer be considered to reflect any technical principle, see also footnote 60.

[76] As the functional limitation implies that the specific technical purpose of the simulation must be reflected in the claimed steps; see T 1227/05, reason 3.1.2.

[77] T 489/14, reasons 46 - 48.

and German jurisprudence[78] appear to have reached similar conclusions on the presence of technical effect, although the CII examination methodologies used by UK High Court of Justice and German Federal Court of Justice differ from the "any technical means" and the Comvik approach used by the EPO. The CII examination methodology used by French Courts also differs from the one used by the boards of appeal of the EPO and in the EPO practice. In particular, in France, an exclusion from patentability is not overcome by a mere implementation on a general-purpose computer[79]. The particular question of the patentability of computer-implemented simulations of technical systems or processes appears not to have been addressed by French Courts.

49. In the UK, HHJ Birss QC in *Halliburton Energy Services Inc.'s Applications* addressed the patentability of computer-implemented simulations of technical systems or processes[80]. The claim in question was construed as being directed to a "simulation process carried out on a computer" and was thus not excluded from patentability as a mental act. The judge adopted a narrow interpretation of the mental act exclusion and considered that if a claimed method cannot be performed by purely mental means, it is irrelevant whether its steps could, in principle, be carried out mentally. The coherence of these considerations with the reasoning in T 1227/05 *INFINEON* was noted.[81]. No direct link to physical reality going beyond the computer-implementation was required in this decision. The UKIPO amended the relevant section of its Manual of Patent Practice in accordance with this decision[82].

50. In the decision *Logikverifikation*[83] the German Federal Court of Justice considered that the claimed subject-matter[84], admittedly based on a mental concept, was deemed to be technical because putting the concept into practice had required technical considerations which related to integrated circuits and which were reflected in the claim. This decision was a further step in the development of the assessment of computer-implemented inventions in Germany[85]. Importantly, the Federal Court of Justice stressed that the understanding of what is to be considered technical is not static. Rather, it is

[78] *Halliburton Energy Services Inc.'s Applications*, 05.10.2011 (Birss J.), [2011] EWHC 2508 (Pat); BGH, X ZB 11/98, GRUR 2000, 498 – *Logikverifikation.*

[79] See, for example, Cour d'appel de Paris, 26.02.2016 (15/01962) – Sesame Active System c. Directeur de l'INPI; Cour d'appel de Paris, 16.12.2016 (14/06444) – Dassault c. Sinequa.

[80] *Halliburton Energy Services Inc.'s Applications*, 05.10.2011 (Birss J.), [2011] EWHC 2508 (Pat).

[81] *Halliburton Energy Services Inc.'s Applications*, 05.10.2011 (Birss J.), [2011] EWHC 2508 (Pat), [58]-[62], [65]. As designing drill bits was "obviously a highly technical process", the claimed method of designing drill bits using a simulation was found to be "highly technical", ibid [66]-[75].

[82] See https://webarchive.nationalarchives.gov.uk/20140603104255/http://www.ipo.gov.uk/pro-types/pro-patent/p-law/p-pn/p-pn-patentability.htm, accessed 5 July 2019; cf. MOPP, Section 1: Patentability (see under section (c)).

[83] BGH, X ZB 11/98, GRUR 2000, 498 – *Logikverifikation.* This decision is considered to be a development of the understanding of what is technical in patent law terms and is followed by the German Patent Court, BPatG Beschluss vom 04.05.2017 - 17 W (pat) 46/16.

[84] The claims related to a method for verifying the translation of a logic plan for an integrated circuit into a physical layout design. The Federal Court noted that the claimed method related to an intermediate step in a process of developing and manufacturing silicon chips.

[85] Moufang in Schulte, Patentgesetz mit Europäischem Patentübereinkommen, 10th edn (Carl Heymanns Verlag 2017) § 1 Rn 20; Günter Schölch, *Patentschutz für computergestützte Entwurfsmethoden - ein Kulturbruch?*, GRUR 2006, 969, 971; Rudolf Kraßer, *Erweiterung des patentrechtlichen Erfindungsbegriffs?*, GRUR 2001, 959, 962 - 963.

open to modification, should technological development and efficient patent protection so require[86]. Whether an application directed to subject-matter listed as being not patentable if claimed as such[87] has the required technicality is to be determined on the basis of an overall consideration of the subject matter of the application in the individual case. Technical considerations which can only originate from a technically skilled person have to be considered when assessing the technicality of a computer-implemented method which is an intermediate step in a production process[88]. This is not precluded by the fact that the claimed teaching does not make direct use of controllable natural forces (beyond the electronic processes internal to any computer) to achieve a causally foreseeable result, as was demanded in the decision *Rote Taube*[89]. With regard to mathematical methods using measurements to decide on the position, speed etc. of an airplane the German Federal Court of Justice noted in the decision *Flugzeugzustand* that mathematical methods are generally used to describe general principles underlying natural phenomena. Without making reference to the measurements made in the case underlying its decision the Federal Court indicated that mathematical methods used to achieve a technical effect are considered technical[90].

51. It follows that the German Federal Court of Justice supports a dynamic interpretation of the terms “technical” and “technicality”. According to the Court, the concept of “technicality” is accessible to modifications if technological development requires it to allow for effective patent protection[91]. Where an invention claims subject matter which might be excluded from patentability as such, technical considerations and technical effects achieved have to be taken into account[92].

VII SUMMARY

52. The principle of narrow interpretation of the exclusions from patentability and the dynamic understanding of the terms “technical” and “technology” are shared between the EPO and major jurisdictions. These principles allow for accommodating new technological developments in the legal framework of the EPC.

53. Within this framework, the established problem-solution approach provides for the assessment of the patentability of computer-implemented simulations of technical systems or processes.

[86] BGH, X ZB 11/98, GRUR 2000, 498 – *Logikverifikation,* reasons II, 4. h).
[87] § 1 (3), (4) PatG (DE), Article 52 (2), (3) EPC.
[88] BGH, X ZB 11/98, GRUR 2000, 498 – *Logikverifikation,* reasons II, 4. f) - g).
[89] BGH, X ZB 11/98, GRUR 2000, 498 – *Logikverifikation*, reasons II, 4. h); BGH X ZB 15/67, GRUR 1969, 672 – *Rote Taube*, reasons II, A, 3.
[90] BGH, X ZB 1/15 - *Flugzeugzustand,* reasons III, 2 b), para 27.
[91] BGH, X ZB 11/98, GRUR 2000, 498 – *Logikverifikation*, reasons II, 4. h).
[92] BGH, X ZB 11/98, GRUR 2000, 498 – *Logikverifikation*, reasons II, 4. f).