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Datasheet for the interlocutory decision of 22 February 2019

Case Number: T 0489/14 - 3.5.07

Application Number: 03793825.5

Publication Number: 1546948

IPC: G06F17/50

Language of the proceedings: EN

Title of invention:
Simulation of the movement of an autonomous entity through an environment

Applicant:
Connor, James Douglas

Headword:
Pedestrian simulation/CONNOR

Relevant legal provisions:
EPC Art. 52(1), 52(2), 52(3), 56, 112(1)(a)

Keyword:
Patentable invention - simulation method
Referral to the Enlarged Board of Appeal

Decisions cited:
G 0001/03, G 0001/04, G 0002/07, G 0003/08, G 0001/12, T 0208/84, T 0115/85, T 0163/85, T 0453/91, T 0769/92, T 0939/92, T 0190/94, T 1173/97, T 0641/00, T 0125/01, T 0914/02, T 0258/03, T 0424/03, T 0154/04, T 1351/04, T 0365/05, T 0471/05, T 1147/05, T 1227/05, T 1567/05, T 1029/06, T 1820/06, T 0887/07, T 1670/07, T 1806/07, T 1875/07, T 0531/09, T 1265/09, T 0309/10, T 1842/10, T 0625/11, T 1630/11, T 0988/12, T 2330/13
German Federal Supreme Court: BGH, 13 December 1999, X ZB 11/98, GRUR 200, 498 - Logikverifikation
Halliburton Energy Services, Inc. v Smith International (North Sea) Limited et al. [2005] EWHC 1623 (Pat) (21 July 2005)
Halliburton Energy Services, Inc. v Comptroller-General of Patents [2011] EWHC 2508 (Pat) (5 October 2011)

Catchword:
The following questions are referred to the Enlarged Board of Appeal for decision:

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?

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Case Number: T 0489/14 - 3.5.07

I N T E R L O C U T O R Y D E C I S I O N
of Technical Board of Appeal 3.5.07
of 22 February 2019

Appellant: (Applicant)
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Decision under appeal:
Decision of the Examining Division of the European Patent Office posted on 26 August 2013 refusing European patent application No. 03793825.5 pursuant to Article 97(2) EPC

Composition of the Board:

Chairman R. Moufang
Members: R. de Man
P. San-Bento Furtado

Summary of Facts and Submissions

I. The applicant (appellant) appealed against the decision of the Examining Division refusing European patent application No. 03793825.5, published as international application WO 2004/023347.

II. Citing no documents, the Examining Division decided that the subject-matter of claim 1 of the then main request and first to third auxiliary requests lacked inventive step.

In respect of claim 1 of the main request and the first and second auxiliary requests, which related to the computer-implemented simulation of the movement of an autonomous entity through an environment, it essentially argued that the simulation model was non-technical and that its implementation on a computer was obvious.

In respect of claim 1 of the third auxiliary request, which had been limited to a method of designing a building structure comprising a step of simulating the movement of pedestrians through the building structure, it argued that the claimed simulation of pedestrian movement did "not contribute to the technical purpose of the claim which is designing a building structure because none of the features or aspects of the numerical model is functionally limited to the technical purpose of designing a building structure". It rejected the appellant's argument that the simulation constituted an essential part of the design process of a building structure in that it allowed the designer to validate its design, because the claim did not specify how the process of designing a building structure was connected to the simulation process.

III. In the statement of grounds of appeal, the appellant replaced his requests with amended main and first and second auxiliary requests.

IV. In a communication accompanying the summons to oral proceedings, the Board noted, *inter alia*, that the case bore some similarity to decision T 1227/05 (OJ EPO 2007, 574), in which the numerical simulation of a noise-affected circuit had been found to be a functional technical feature. Nevertheless, it tended to the view that the simulation method underlying claim 1 of each request did not contribute to the technical character of the invention and that the subject-matter of claim 1 of each request lacked inventive step.

V. By letter of 9 March 2018, the appellant filed third, fourth and fifth auxiliary requests.

VI. Oral proceedings took place on 11 April 2018, during which the necessity of referring one or more questions to the Enlarged Board of Appeal was discussed. At the end of the oral proceedings, the chairman announced that the proceedings would be continued in writing.

VII. In a letter dated 25 June 2018, the appellant proposed the following questions for referral:

"I. Can a computer-implemented method of simulation based on laws of physics or calculating values which represent physical quantities for aiding the design of technical aspects of a physical system or technical product or for aiding the technical operation of a physical system or technical product be considered to

be or to serve a technical purpose provided the technical purpose is adequately defined?

II. If the answer to question I is 'No', in a claim directed to a method of designing, making or operating the physical system or technical product and which recites steps in a method of simulation for aiding the design of technical aspects of the physical system or technical product or for aiding technical operation of the physical system or technical product, would the simulation method steps be considered as contributing to the technical character of the claim and, thus, be considered in an assessment of inventive step?

III. 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[?]"

VIII. The appellant requests that the decision under appeal be set aside and that a patent be granted on the basis of the claims of the main request or, in the alternative, on the basis of the claims of one of the first to fifth auxiliary requests.

IX. Claim 1 of the main request reads as follows:

"A computer-implemented method of modelling pedestrian crowd movement in an environment, the method comprising:

simulating movement of a plurality of pedestrians through the environment, wherein simulating movement of each pedestrian comprises:

providing a provisional path (9) through a model of the environment from a current location (6) to an intended destination (7);

providing a profile for said pedestrian;

determining a preferred step (11_2'), to a preferred position (12_3'), towards said intended destination based upon said profile and said provisional path, wherein determining said preferred step comprises determining a dissatisfaction function expressing a cost of taking a step comprising a sum of an inconvenience function expressing a cost of deviating from a given direction and a frustration function expressing a cost of deviating from a given speed;

defining a neighbourhood (29) around said preferred position (12_3');

identifying obstructions in said neighbourhood, said obstructions including other pedestrians (21) and fixed obstacles (25);

determining a personal space (24) around said pedestrian;

determining whether said preferred step (11_2') is feasible by considering whether obstructions (21, 25) infringe said personal space over the course of the preferred step (11_2')."

X. Claim 1 of the first auxiliary request differs from claim 1 of the main request in that "environment" has been replaced with "building structure".

XI. Claim 1 of the second auxiliary request differs from claim 1 of the first auxiliary request in that the following text has been inserted after "providing a profile for said pedestrian,":

"said profile including a preferred walking speed;
determining a preferred instantaneous walking speed by adding said preferred walking speed to a value of walking speed noise;"

and in that "a cost of deviating from a given speed" has been replaced with "a cost of deviating from the preferred instantaneous walking speed".

XII. Claim 1 of the third auxiliary request differs from claim 1 of the second auxiliary request in that the following text has been added at the end of the claim:

"and
displaying the simulated movement as a sequential set of snapshots showing the current position of each pedestrian in the model as it progresses over time."

XIII. Claim 1 of the fourth auxiliary request differs from claim 1 of the third auxiliary request in that the text before "providing a provisional path" has been replaced with:

"A method of designing a building structure, the method comprising:
- providing a model of said building structure;
- simulating movement of a plurality of pedestrians through said building structure using a computer, wherein simulating movement of each pedestrian step comprises:"

and in that the following text has been added at the end of the claim:

"and
- revising said model of said building structure in dependence upon movement of the pedestrians."

XIV. Claim 1 of the fifth auxiliary request differs from claim 1 of the third auxiliary request in that the following text has been inserted before "and displaying the simulated movement":

"if the preferred step is not feasible, then:
determining a region in which to seek a compromise step, wherein determining the region in which to seek the compromise step comprises adapting step parameters for determining said region in dependence upon memory of past conditions; and
determining whether at least one compromise step is feasible;"

XV. The appellant's arguments can be summarised as follows:

The application concerned modelling pedestrian movement, which could be used to help design or modify a venue. It sought a more accurate and realistic simulation of pedestrian crowds in real-world situations, which could not be adequately modelled by conventional simulators. The application was based, at least in part, on the insight that human interaction could be expressed and modelled in the same way as physical interactions.

In claim 1 of the main request, which was now directed to a method of modelling pedestrian crowd movement in an environment by means of simulation, the method steps

contributed to the technical character of the invention in two ways. First, the method steps were themselves technical features, as they related to physical parameters which could be expressed in terms of physical quantities and involved applying physical laws of motion and considerations of cost or work. Second, they contributed to the technical character of the invention by virtue of their interaction with the computer. The method of claim 1 produced a technical effect in the form of a more accurate simulation of crowd movement. Following decision T 1227/05, modelling pedestrian crowd movement in an environment constituted an adequately defined technical purpose for a computer-implemented method. The claimed method yielded accurate and repeatable results no different from those produced by a method of modelling an electron using a similar numerical method. Moreover, the claimed simulation method was no more suited to being carried out mentally than the simulation method considered in decision T 1227/05.

The aspects of the simulation method that were based on considerations of human behaviour, such as the concept of personal space, were modelled by equations similar to those describing the laws of physics and therefore also provided a technical contribution.

Claim 1 of the first and second auxiliary requests further clarified that the invention related to physical quantities and parameters.

The third, fourth and fifth auxiliary requests helped clarify the effect outside the computer and emphasised that the process was one which could not be performed simply with the help of pencil and paper.

The board in case T 1227/05 had adopted a correct approach. It had recognised the importance of simulations and had understood the practical issues in claiming them. This approach had been followed in decision T 625/11 of 19 January 2017.

In the appellant's question I, the term "technical aspects of a physical system or technical product" was intended to cover the layout of a built structure such as a railway station. Accurately simulating crowd movement could be used to aid the design of the built environment by guiding physical changes to the environment that would improve performance of the built structure. Question I reflected the approach adopted in decision T 1227/05 and was to be answered in the affirmative. Question II was suggested as a fallback and was also to be answered in the affirmative.

Question III was likewise to be answered with "yes". The types of structure or product which benefited from simulation were not limited to electronic circuits and nuclear reactors but extended to environments such as stadiums and railway stations and also to transport infrastructure. The movement of the relevant actors, such as pedestrians, could be modelled accurately and repeatably using a set of governing laws akin to laws of physics.

Reasons for the Decision

Admissibility of the appeal

1. The appeal complies with the provisions referred to in Rule 101 EPC and is therefore admissible.

The application

2. The invention relates to a computer-implemented method, computer program and apparatus for simulating the movement of a pedestrian crowd through an environment.

The published application, on pages 11 to 56, describes a mathematical model of individual pedestrians and an algorithm for simulating their movement through an environment. This is followed, on pages 56 to 70, by the description of a design system which performs the simulation. This system, shown in Figure 21, allows the user to build a model of an environment by creating it or importing a design from a computer-aided-design (CAD) source (page 58, lines 28 to 32). During the execution of the simulation, a sequential set of snapshots is displayed showing the current position of each pedestrian in the modelled environment. These simulation results can be analysed either online, i.e. while the simulation is running, or offline after the simulation has finished and the results have been recorded (page 60, line 18, to page 61, line 5).

The main purpose of the simulation is its use in a process for designing a venue such as a railway station or a stadium, as shown in Figure 22 and described on pages 65 to 70. Essentially, the designer creates or imports an architectural venue design, specifies the constituents of a pedestrian population that is typical for the venue being designed, and performs a number of simulations of pedestrian flows which the designer can specify at a high level (in terms of sources (entrances), sinks (exits) and supply rate). The simulation results are then examined and the design is revised if necessary.

In addition to the use of the simulation method for designing venues, the description, on page 3, lines 17 to 19, also mentions its use for troubleshooting flow problems, operational management, setting and implementing safety standards and quality control. These purposes are not independently elaborated elsewhere in the application.

Examination of claim 1 of the main request

3. Claim 1 of the main request relates to a computer-implemented method of modelling pedestrian crowd movement in an environment. The method simulates a plurality of pedestrians as they move through the environment. For each pedestrian, a "preferred step" is determined on the basis of a pedestrian-specific profile, a provisional path through a model of the environment and certain "dissatisfaction", "inconvenience" and "frustration" cost functions, and it is furthermore determined whether the step is feasible in view of obstructions in the neighbourhood of the pedestrian and the pedestrian's personal space.

4. Ignoring for a moment the feature "computer-implemented", claim 1 specifies a series of procedural steps which could be performed independently of any specific technical means. They can be carried out with the help of a computer, but also - at least in principle - exclusively mentally. In other words, without the feature "computer-implemented", the scope of claim 1 encompasses methods for performing mental acts as such, which are excluded from patentability under Article 52(2) and (3) EPC.

In this context the Board notes that, as a matter of practical reality, someone carrying out the prescribed

sequence of steps for a larger number of pedestrians and a more complicated environment may need some help, for example in the form of pencil and paper, to keep track of intermediate calculation results or to visualise the end results. But complexity of an activity is not normally considered to be sufficient to escape the mental act exclusion (see e.g. decision T 309/10 of 19 June 2013, reasons 16).

5. The appellant argued that the steps of claim 1 were in fact technical because they dealt with physical concepts, such as direction and length, which could be expressed in terms of physical quantities. However, a method that can be performed mentally is still excluded even if it can be said to involve technical considerations. In opinion G 3/08 (OJ EPO 2011, 10), the Enlarged Board confirmed this when it explained that no contradiction existed between the statement that programming - more precisely, the intellectual activity of working out what are the steps to be included in a computer program - always involved technical considerations and the statement that programming was a mental act excluded from patentability (reasons 13.3). The Enlarged Board drew the following analogy:

"Designing a bicycle clearly involves technical considerations (it may also involve non-technical, e.g. aesthetic, considerations) but it is a process which at least initially can take place in the designer's mind, i.e. it can be a mental act and to the extent that it is a mental act would be excluded from patentability, just as in the cited cases T 833/91, T 204/93 and T 769/92 (cf. also T 914/02, General Electric, dated 12 July 2005, Reasons, point 2.3 and T 471/05, Philips, dated 06 February 2007, Reasons, points 2.1 and 2.2)."

6. The presence of non-technical features in claim 1 does not mean, however, that its subject-matter is excluded from patentability under Article 52(2) and (3) EPC as a "non-invention". The limitation to a "computer-implemented" method ensures that any embodiment of the claimed invention involves the use of a computer, which is undoubtedly a technical means. It is well established in the jurisprudence of the boards of appeal that a method claim involving technical means is not excluded from patentability (see decision T 258/03, OJ EPO 2004, 575, reasons 4).

This narrow interpretation of the exclusions of Article 52(2) and (3) EPC is based on the principle that whether particular subject-matter is excluded is to be decided without regard to the prior art. In decision G 2/07 (OJ EPO 2012, 130), the Enlarged Board confirmed this principle when it held that the same should apply to the delimitation of essentially biological from patentable processes for the production of plants or animals (reasons 6.4.1).

7. On the other hand, the jurisprudence also holds that inventive step can be based only on the technical part of the invention, i.e. on those features that contribute to the solution of a technical problem; features that cannot be considered as contributing to the solution of any technical problem by providing a technical effect have no significance for the purpose of assessing inventive step (see T 641/00, OJ EPO 2003, 352, reasons 4 to 6; G 3/08, reasons 12.2.1 and 12.2.2). Non-technical features are therefore to be taken into account in the assessment of inventive step to the extent that they interact with the technical subject-matter of the claim to solve a technical

problem or, equivalently, to bring about a technical effect (see G 1/04, OJ EPO 2006, 334, reasons 5.3; T 154/04, OJ EPO 2008, 46, reasons 5, under (F), and 13 to 15).

8. In the present case, the method steps of claim 1 interact with the feature requiring the method to be "computer-implemented" at least to the extent that the method steps are to be implemented on a computer.

In some cases, the problem of implementing a non-technical method on a computer may have a non-obvious solution, namely if the implementation requires non-trivial technical features. In such cases, those technical features are essential features of the invention and thus have to be included in the claim in order to comply with Rule 43(1) and (3) EPC. This is not such a case: the implementation of the steps of claim 1 is straightforward, requiring only basic knowledge of data structures and algorithms.

In other cases, the implementation of a non-technical method on a computer may in itself be a straightforward programming exercise, but the design of the method may still have been motivated by technical considerations concerning the internal functioning of the computer, resulting in a specific technical effect being achieved when the method is run on the computer (see e.g. decision T 2330/13 of 9 May 2018, reasons 5.7.9 and 5.7.10). In those cases, the technical problem to be solved cannot be formulated as being how to implement the non-technical method on a computer but has to be reformulated, essentially, as being how to achieve the effect. But this is not one of those cases either, as the steps of claim 1 directly reflect the simulation to be performed, and no considerations relating to the

internal functioning of a computer are alluded to in the application or can otherwise be recognised by the Board.

Hence, if its implementation on a computer were to be considered the only technical aspect of the claimed method, the conclusion would be that the method lacks inventive step over a known general-purpose computer.

9. It therefore has to be assessed whether further technical aspects can be identified in the subject-matter of claim 1. In this respect, the appellant submitted that the invention produced a technical effect in the form of "a more accurate simulation of crowd movement". Since a general-purpose computer does not inherently simulate crowd movement at all, the appellant's submission amounts to the argument that the computer-implemented simulation of crowd movement qualifies as a technical effect and that the steps of claim 1 contribute to that effect.

The Board observes that claim 1 does not explicitly specify what information is ultimately provided to the user of the method, but it accepts that claim 1 provides information about the simulated movement of pedestrians through a modelled environment.

10. As to the technicality of simulating crowd movement, the appellant argued that simulating the movement of pedestrians yielded results which were no different from those obtained by modelling an electron using numerical methods. Like the simulation of an electron, the claimed simulation of the movement of pedestrians was based, at least in part, on the laws of physics.

The Board does not disagree with these observations but is not convinced that numerically calculating the trajectory of an object as determined by the laws of physics is in itself a technical task producing a technical effect.

11. In the Board's view, a technical effect requires, at a minimum, a direct link with physical reality, such as a change in or a measurement of a physical entity. Such a link is not present where, for example, the parabolic trajectory followed by a hypothetical object under the influence of gravity is calculated. Nor can the Board detect such a direct link in the process of calculating the trajectories of hypothetical pedestrians as they move through a modelled environment, which is what is claimed here. In fact, the environment being modelled may not exist and may never exist. And the simulation could be run to support purely theoretical scientific investigations, or it could be used to simulate the movement of pedestrians through the virtual world of a video game.

In this context, the Board notes that the Enlarged Board of Appeal in decision G 2/07, reasons 6.4.2.1, stated that "[h]uman intervention, to bring about a result by utilising the forces of nature, pertains to the core of what an invention is understood to be". It appears to the Board that using a computer to calculate the trajectories of hypothetical pedestrians as they move through a modelled environment does not utilise the forces of nature to bring about a result in any way different from using a computer to perform any other type of calculation.

12. The Board's analysis so far would lead it to conclude that the subject-matter of claim 1 indeed lacks

inventive step over a known general-purpose computer. However, the appellant also relied on decision T 1227/05, arguing that modelling pedestrian crowd movement in an environment constituted an adequately defined technical purpose for a computer-implemented method.

Decision T 1227/05

13. In case T 1227/05, the deciding board came to the conclusion that the claimed numerical simulation of a noise-affected circuit described by a model featuring input channels, noise input channels and output channels and a system of differential or algebroid differential equations was a functional technical feature.

The board was satisfied that the claim was limited to the simulation of "an adequately defined class of technical items" ("eine hinreichend bestimmte Klasse von technischen Gegenständen"), where "adequately defined" appears to be essentially a clarity requirement (reasons 3.1 and 3.1.1). The board's reasons for finding the simulation to be a technical process are given in point 3.2.2 of the reasons, which reads as follows:

"Die Simulation erfüllt technische Aufgaben, die für eine moderne Ingenieurtätigkeit typisch sind: Die Simulation erlaubt eine realitätsnahe Vorhersage des Verhaltens eines entworfenen Schaltkreises und unterstützt dadurch dessen Entwicklung im Idealfall so genau, dass vor einer Fertigung abgeschätzt werden kann, ob der Bau eines Prototyps Erfolg verspricht. Die technische Bedeutung dieses Ergebnisses vervielfacht sich mit zunehmender Geschwindigkeit des

Simulationsverfahrens, denn damit kann eine umfangreiche Klasse von Entwürfen virtuell getestet und auf erfolgversprechende Kandidaten durchsucht werden, bevor mit einer aufwendigen Herstellung von Schaltkreisen begonnen wird.

Ein vorausschauender Test eines komplexen Schaltkreises und/oder eine qualifizierte Auswahl aus einer Vielzahl von Entwürfen wäre ohne technische Hilfe nicht oder nicht innerhalb annehmbarer Zeit möglich. Das computergestützte Simulationsverfahren zum virtuellen Ausprobieren stellt somit ein praktisches und praxisrelevantes Werkzeug des Elektroingenieurs dar. Dieses Werkzeug ist gerade deshalb wichtig, weil in der Regel keine rein mathematische, theoretische oder gedankliche Methode existiert, die eine vollständige und/oder schnelle Voraussage des Schaltkreisverhaltens unter Rauscheinflüssen liefern würde."

[The English translation in the Official Journal reads: "Simulation performs technical functions typical of modern engineering work. It provides for realistic prediction of the performance of a designed circuit and thereby ideally allows it to be developed so accurately that a prototype's chances of success can be assessed before it is built. The technical significance of this result increases with the speed of the simulation method, as this enables a wide range of designs to be virtually tested and examined for suitability before the expensive circuit fabrication process starts.

Without technical support, advance testing of a complex circuit and/or qualified selection from many designs would not be possible, or at least not in reasonable time. Thus computer-implemented simulation methods for virtual trials are a practical and practice-oriented

part of the electrical engineer's toolkit. What makes them so important is that as a rule there is no purely mathematical, theoretical or mental method that would provide complete and/or fast prediction of circuit performance under noise influences."]

14. In the present case, the method of claim 1 can be viewed as a method of testing - by simulation - a modelled environment with respect to pedestrian crowd movement. Viewed in this way, there is an evident analogy with a method of testing - by simulation - a modelled circuit with respect to noise influences. Just as the simulation method claimed in T 1227/05 can be used to predict the performance of a designed circuit in the presence of noise before it is built, so too can the simulation method claimed here be used to predict the performance of a designed environment in the presence of pedestrians before it is constructed. (The claims in both cases refer to a "modelled" rather than a "designed" circuit and environment.)

Although the term "environment" is broad, the claim is limited to the simulation of environments through which pedestrians move and which have fixed obstacles. The Board considers that such environments, when they exist in physical reality, are technical and that an environment's "behaviour" when a crowd of pedestrians moves through it, for example the rate at which pedestrians can pass through the environment, is a technical property of the environment, not unlike the ability of a roof to drain rainwater. While it is true that the movement of a pedestrian is determined to a large extent by subjective decisions taken by the pedestrian, ultimately the pedestrian's movement cannot fail to obey the laws of physics: a pedestrian cannot move through a wall or through other pedestrians.

Designing a train station that can handle a million people passing through it per day or a building that can be evacuated within a matter of minutes is primarily the work of an engineer, even if the insights of a behavioural psychologist can be of assistance.

As noted above, at least in principle the calculations underlying the simulation of pedestrian crowd movement as claimed here *can* be performed purely mentally; the role of the computer is that of ensuring satisfactory and reliable performance. But the same can be said of the method considered in T 1227/05. In both cases, the practical usefulness of the simulation method increases with the speed at which it is executed, as a greater speed allows a wider range of designs to be virtually tested and examined for suitability before the expensive manufacturing or construction process starts. In both cases, advance testing of a complex circuit or environment or an appropriate selection from many designs would not be possible within a reasonable time without computer support.

15. In sum, the Board agrees with the appellant that decision T 1227/05 supports his case. However, the Board is not fully convinced by the decision's reasoning. Its doubts are twofold.

First, although a computer-implemented simulation of a circuit or environment is a tool that can perform a function "typical of modern engineering work", it assists the engineer only in the *cognitive* process of verifying the design of the circuit or environment, i.e. of studying the behaviour of the virtual circuit or environment designed. The circuit or environment, when realised, may be a technical object, but the

cognitive process of theoretically verifying its design appears to be fundamentally non-technical.

Second, the decision appears to rely on the greater speed of the computer-implemented method as an argument for finding technicality. But any algorithmically specified procedure that can be carried out mentally can be carried out more quickly if implemented on a computer, and it is not the case that the implementation of a non-technical method on a computer necessarily results in a process providing a technical contribution going beyond its computer implementation (see e.g. decision T 1670/07 of 11 July 2013, reasons 9).

16. Decision T 1227/05 indirectly addresses the claimed simulation method's lack of a direct physical effect on the real world in point 3.4 of its reasons, where decision T 453/91 of 31 May 1994 is discussed. In that case, the deciding board had insisted on the addition of a step of "materially producing the chip so designed" to a method for designing a chip, because the claims rejected by the examining division concerned methods that could be interpreted as delivering a mere design which did not exist in the real world and which could or could not become a real object (see T 453/91, reasons 5.2).

The board which decided T 1227/05 acknowledged the tension with decision T 453/91. It pointed out that industrial simulation methods were becoming more and more crucial to technological progress and that, in a globally distributed industry, development and production were becoming increasingly separated, both materially and geographically. It therefore considered specific patent protection to be appropriate for

numerical development tools designed for a technical purpose (reasons 3.4.2).

There is no doubt that the significance of numerical development tools has increased even more since case T 1227/05 was decided, yet the Board is hesitant to base its decision on policy considerations relating to the appropriate scope of patent protection that have not been expressed by the legislator and have in fact arisen only since the relevant provisions of the EPC were enacted (the Diplomatic Conference for the revision of the EPC in 2000 not having materially changed them). The Board is aware that the legislator deliberately refrained from defining the terms "technical" and "technology" in order not to preclude adequate protection being available for the results of future developments in fields of research which the legislator could not foresee (cf. decision G 2/07, reasons 6.4.2.1), but it sees a difference between the emergence of a new field of innovation and a change in the perceived significance of an existing field.

17. Nevertheless, in view of the important role that numerical development tools and in particular computer-implemented simulations play nowadays in the development of new products, legal certainty in respect of the patentability of such tools is highly desirable. Although the Board would tend to consider the subject-matter of claim 1 of the main request to lack inventive step over a general-purpose computer, it recognises that the approach developed in case T 1227/05 suggests a different finding. That approach has so far not been adopted in a great many decisions of the boards of appeal, but it is the approach which currently prevails in the jurisprudence (see Case Law of the Boards of Appeal, 8th edition, 2016, I.A.2.4.3, under f)). It is

also included in Part G, Chapter II, 3.3.2, of the Guidelines for Examination in the EPO (November 2018).

18. Were the Board to follow decision T 1227/05, it would have to acknowledge that some or all of the steps of the simulation method of claim 1 contribute to a technical effect of the invention and could thus not be ignored when assessing inventive step. It would hence be necessary to compare the invention with prior art other than a general-purpose computer. Such prior art is available but was not considered in the decision under appeal. The Board would therefore remit the case to the Examining Division for further prosecution.

19. The present case therefore requires a decision to be taken on - to put it in general terms for now - the patentability of simulation methods. This is a point of law which relates to the interpretation of Articles 52(2) and (3) and 56 EPC and cannot be answered directly and unambiguously by reference to the EPC, i.e. it is a point of law of fundamental importance (cf. decision G 1/12, OJ EPO 2014, A114, reasons 10). The answer is important not just for the present case but for a potentially large number of cases involving computer-implemented simulations (see, for example, the decisions discussed in points 38 to 41 below, which were taken by four other organisational boards of appeal). Moreover, the Board at present intends to deviate from the interpretation and explanations of the EPC given on this point in decision T 1227/05 so that the uniform application of the law is also at issue. The Board further notes that the considerations necessary for settling the point of law are likely to help clarify the meaning of Article 52(2) and (3) EPC and its interaction with Article 56 EPC more generally. The Board therefore considers that it

should refer the point of law to the Enlarged Board of Appeal in the form of the questions formulated below.

Questions to be referred

20. Before formulating its questions, the Board will briefly recapitulate its position.

In the assessment of inventive step of an invention involving both technical and non-technical features, the non-technical features are to be taken into account only to the extent that they interact with the technical features to solve a technical problem/produce a technical effect over the prior art. In the case of the computer-implemented method of claim 1, it is not evident that the non-technical method steps interact with the technical features to produce a technical effect going beyond the straightforward implementation of the method on a computer. The crucial question is whether, starting from a known general-purpose computer as the closest prior art, the computer-implemented simulation achieved by the method of claim 1 can itself be regarded as a technical effect for the purpose of assessing inventive step.

The Board would tend to answer this question in the negative for the reasons given in point 11 above. At the same time, as set out in point 14 above, it considers the present case to concern a computer-implemented simulation that, according to decision T 1227/05 (but contrary to the Board's view), would constitute a functional technical feature.

21. One point to consider is the scope of the term "simulation". In a strict sense, a simulation is 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.

The Board notes that the answers or reasons which may be given by the Enlarged Board may apply to a broader class of computations. In particular, there may be no ground to distinguish between simulating, i.e. approximately imitating, the operation of a system based on a model of the system and otherwise using a model to assess or predict the functioning of the system.

Another class of computations to which the answers or reasons given by the Enlarged Board could potentially apply is suggested by the "Logikverifikation" decision of the German Federal Supreme Court, which is discussed in point 46 below and which could be understood as holding that the claimed verification, based on technical considerations, of aspects of a model or a design makes a technical contribution if the verification can serve as an intermediate step in the process of developing and manufacturing a technical product.

Since the computer-implemented simulation of present claim 1 is a simulation in the strict sense, the Board will limit its questions accordingly.

22. Hence, the first question to be referred to the Enlarged Board is:

"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?"

23. If the Board's position that a technical effect requires a direct link with physical reality is not correct, the question arises as to what is required of a computation for it to produce a "technical effect" for the purpose of assessing inventive step under the EPC. The exclusion by Article 52(2)(c) and (3) EPC of "programs for computers as such" seems to signify that not all computations produce technical effects.

In the case of a computer-implemented simulation, decision T 1227/05 requires that the simulation concerns an "adequately defined class of technical items". In this Board's reading of that decision, the requirement "adequately defined" ("hinreichend bestimmt") is a clarity requirement. Indeed, merely limiting the claim to the simulation of a "technical system" was said to result in an inadequate "metaspecification", in conflict with Article 84 EPC (reasons 3.1.1).

Nevertheless, it appears to the Board that something more is needed than a (clear) limitation to simulated items that are technical. For example, decision T 531/09 of 3 May 2012 concerned the simulation of a security checkpoint which included technical equipment such as a metal detector and an X-ray device. The deciding board took the view, however, that the claimed simulation in that case was not technical because the metal detector and the X-ray device were not modelled any differently from any of the non-technical tasks at the checkpoint, namely in terms of estimated queuing

delays. Several other decisions also appear to have read a further condition (i.e. a substantive condition unrelated to the issue of clarity) into the requirement of T 1227/05 that the simulation concerns an "adequately defined class of technical items" (see e.g. decision T 1806/07 of 6 March 2012, reasons 3.3 to 3.5, and the remaining decisions discussed in points 38 and 41 below).

If the answer to the first question is yes, the Board is inclined to consider it still to be a necessary condition for a computer-implemented simulation of a technical system or process to produce a technical effect that the simulation reflects technical principles or considerations underlying the process or system being simulated. As explained in point 14 above, the Board considers that the simulation of present claim 1 is in fact based, at least in part, on technical principles underlying the process being simulated. However, the Board is not certain that this condition would be sufficient and that it corresponds to how decision T 1227/05 has been interpreted in later decisions.

24. Thus the second question to be referred is:

"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?"

25. A negative answer to the first question would mean that the subject-matter of claim 1 of the main request lacks

inventive step over a known general-purpose computer. The same would apply if the answer to the second question includes criteria which the Board concludes are not fulfilled in the present case.

The first, second, third and fifth auxiliary requests would then fall with the main request, since the amendments made in them make no material difference for the Board's analysis:

- the first auxiliary request replaces "environment" with "building structure", but the term "environment" is already understood, in the context of claim 1 of the main request, as referring to a technical object (see point 14 above);

- the amendments made in the second and fifth auxiliary requests merely concern the simulation steps;

- the third auxiliary request includes an explicit step of displaying the results of the simulation, but the Board is satisfied that claim 1 of the main request already provides information about the simulated movement of pedestrians through a modelled environment (see point 9 above).

26. In the fourth auxiliary request, claim 1 is directed to a method of designing (a model of) a building structure. The method comprises a step of providing a model, steps of simulating pedestrian movement through the building structure using a computer, and a step of revising the model in dependence upon the movement of the pedestrians. The description of the application makes it clear that the revising step may be performed by a human designer operating a CAD program (see e.g.

page 70, lines 7 to 9, of the international publication).

This amendment limits the claimed computer-implemented simulation to its use in a method of design. Since decision T 1227/05 essentially derives the technicality of a computer-implemented simulation from its significance for modern product development processes, this limitation arguably strengthens the appellant's case. The amendment does not, however, change the Board's present position that the claimed computer-implemented simulation does not contribute to a technical effect, as a direct link with physical reality is still absent.

27. At this point, the Board notes that the claimed computer-implemented simulation helps the designer in carrying out design activities in the sense that the simulation allows the designer to verify how the design performs. But it does not causally lead to an improved environment design (or an improved environment when constructed) because any changes made to the design in response to simulation results are still the result of the intellectual activity of the designer (see T 1875/07 of 5 November 2008, discussed in point 45 below, for a similar situation). In the present case, the limitation to a design process therefore appears to make a difference only if it is considered that the (intellectual) activity of designing an environment or building structure qualifies as a technical process.

28. The third question to be referred is therefore:

"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?"

29. These three questions correspond essentially to questions I and II proposed by the appellant in its letter dated 25 June 2018 (see section VII. above). The appellant formulated a further question III, which reflects another aspect of the discussion during the oral proceedings, namely the extent to which claim features based on psychological considerations could make a technical contribution in the present case.

The Board has contemplated referring a corresponding question in order to be able to give the Examining Division precise guidance on how to proceed further in the event that the claimed computer-implemented simulation were to be found to make a technical contribution over a general-purpose computer. However, it has decided not do so. If the computer-implemented simulation is found to make a technical contribution, it will normally become necessary to compare the invention with prior art other than a general-purpose computer (cf. point 18 above). Whether a question of fundamental importance will arise relating to the technical contribution of features based on psychological considerations depends on the outcome of that comparison and cannot be predicted now.

30. The Board will now discuss and in some cases comment on decisions that may be relevant to the questions being referred.

Requirement of a direct link with physical reality

31. In opinion G 3/08 the Enlarged Board held the referral under Article 112(1)(b) EPC of question 3(a), "Must 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?", to be inadmissible because there was no divergence on this point between decisions T 163/85 (OJ EPO 1990, 379) and T 190/94 of 26 October 1995 on the one hand and decisions T 125/01 of 11 December 2002 and T 424/03 of 23 February 2006 on the other hand. In particular, neither of decisions T 163/85 and T 190/94 had stated that "a technical effect on a physical entity in the real world" was a necessary condition for a feature to contribute to the technical character of the invention (reasons 12.3).

Decision T 163/85 related to the question whether a transient television signal was eligible for patent protection. Decision T 190/94 is more to the point: the deciding board reasoned that the difference between the claimed system and that of the prior art manifested itself in the real world in a technical effect on a physical entity in the sense of decision T 208/84 (OJ EPO 1987, 14).

32. Decision T 208/84 dealt with a method of digitally processing images. In point 5 of its reasons, the deciding board drew a distinction between mathematical methods and technical processes:

"A basic difference between a mathematical method and a technical process can be seen, however, in the fact that a mathematical method or a mathematical algorithm is carried out on numbers (whatever these numbers may represent) and provides a result also in numerical form, the mathematical method or algorithm being only an abstract concept prescribing how to operate on the numbers. No direct technical result is produced by the method as such. 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."

The board hence contrasted methods producing no "direct technical result" with technical processes carried out on a physical entity and effecting a certain change in that entity. The physical entity in that case was an image in the form of a (digitally stored) electric signal.

Decision T 208/84 therefore appears to suggest that a direct link with physical reality is a precondition for a technical effect and to rule out simulations as technical processes (see also decisions T 365/05 of 19 June 2007, reasons 5.10; T 1147/05 of 12 March 2008, reasons 3.4; T 1029/06 of 22 April 2009, reasons 9; and T 531/09, reasons 3).

33. In decision T 1670/07, reasons 13, the deciding board summarised the circumstances in which the provision of data could qualify as a technical effect by stating that "a technical effect may arise from either the provision of data about a technical process, regardless of the presence of a user or its subsequent use, or from the provision of data (including data that on its own is excluded, e.g. produced by means of an algorithm) that is applied directly in a technical process".

In this Board's reading of T 1670/07, the "technical process" being referred to is assumed to be a "real-world" technical process producing "real-world" technical effects rather than a virtual one only producing information.

34. In decision T 769/92 (OJ EPO 1995, 525), the deciding board reasoned that the implementation of a user interface in the form of a "transfer slip" was not merely an act of programming but required technical considerations on the part of the programmer before programming could start; it therefore provided a technical contribution to the art (see reasons 3.7 and 3.8). The very need for such technical considerations "implie[d] the occurrence of an (at least implicit) technical problem to be solved (Rule 27 EPC [1973]) and (at least implicit) technical features (Rule 29 EPC [1973]) solving that technical problem" (reasons 3.3).

This decision therefore suggests that the necessity for technical considerations in the design of a computer-implemented method or system is sufficient for the programming features of the method or system to "implicitly" solve a technical problem or achieve a technical effect and that a direct (real-world) technical effect hence need not be present.

The Board notes that decision T 769/92 still followed the "contribution approach" (see opinion G 3/08, reasons 10.6 and 10.7, for a discussion of the contribution approach and its abandonment) and was concerned with the question whether the claimed subject-matter fell within the exclusions of Article 52(2) and (3) EPC. It may be questioned whether the mere need for technical considerations (and the

consequential "implicit" presence of an unspecified technical problem) is also sufficient to conclude that certain non-technical features make a technical contribution for the purpose of assessing inventive step. Indeed, the problem-solution approach normally applied by the boards of appeal requires the identification of a solution to a specific technical problem.

35. The Enlarged Board, in opinion G 3/08, reasons 13.5, acknowledged that decision T 769/92 had created at least the potential for confusion and pointed out that decision T 1173/97 (OJ EPO 1999, 609) had set the bar higher in the case of computer programs. It suggested that for programming features to have technical character, the programmer must have had technical considerations beyond "merely" finding a computer algorithm to carry out some procedure.

This again could be understood as meaning that the necessity for technical considerations (beyond "merely" finding a computer algorithm to carry out some procedure) in the design of a computer-implemented method or system is sufficient for the programming features of the method or system to "implicitly" solve a technical problem or achieve a technical effect, without a direct (real-world) technical effect needing to be present.

36. But case T 1173/97, in which the "further technical effect" concept was developed to distinguish between computer programs "as such", not having technical character, and computer programs having technical character, appears not to support the above view.

In decision T 1173/97 it was held that a computer program had technical character if, when run on a computer, it produced a "further" technical effect going beyond the normal physical interactions between program and computer (headnote and reasons 6; see also G 3/08, reasons 10). Although a computer program product itself did "not directly disclose the said effect in physical reality", it had the *potential* to produce the effect, namely when it was executed on a computer, and there was no good reason for distinguishing between a direct technical effect and the potential to produce a technical effect (reasons 9.4).

This decision therefore does appear to require a technical effect to be directly linked to physical reality; but it accepts that, in the particular case of a computer program (product), the effect is to be taken into account in the assessment of inventive step even though it is achieved only when the program is executed on a computer.

37. The Board is aware of a number of other cases which suggest that a potential technical effect, i.e. an effect achieved only in combination with non-claimed features, can be taken into account in assessing inventive step. For example, in decision T 1351/04 of 18 April 2007 a method of creating an index file was found to be new and inventive because the created index file could be used in a new and inventive method for searching a file (reasons 8 and 9). And in case T 625/11, the deciding board concluded that the determination of a limit value of an operating parameter of a nuclear reactor on the basis of a simulation contributed to the technical character of the invention, even though the use of the limit value

for the operation of the nuclear reactor was not claimed (see also point 39 below).

As was noted in T 625/11, reasons 7.2.6, an approach whereby inventive step may be based on a technical effect achieved only in combination with non-claimed features contradicts the principle that the effect should be achieved by substantially all embodiments falling within the terms of the claim (see decision T 939/92, OJ EPO 1996, 309, reasons 2.4 to 2.6, endorsed by the Enlarged Board in decision G 1/03, OJ EPO 2004, 413, reasons 2.5.2).

Decisions relating to simulations

38. Decisions T 1265/09 of 24 January 2012, reasons 1.13; T 531/09, reasons 3; and T 1630/11 of 13 January 2017, reasons 7.1, all referred to decision T 1227/05 and expressed reservations as to whether, for a (computer-implemented) simulation method to make a technical contribution to the art, it was a sufficient condition that the simulated items be technical. The board dealing with case T 531/09 noted that in decision T 208/84 it had been held that a technical process was different from a mathematical method in that the technical process was carried out on a physical entity and provided, as its result, a certain change in that entity. It observed that that definition of technical processes seemed to exclude simulation, whose very purpose was to replace physical entities with virtual ones (see also point 32 above).

In none of these cases was it necessary to decide whether the condition formulated in T 1227/05 was sufficient, as the items being simulated (a call center, a security checkpoint, a deployment model and

functional model for a multiprocessing system) were considered not to be technical.

39. The subject of case T 625/11 was a computer-implemented method for establishing a limit value for an operational parameter of a nuclear reactor on the basis of a simulation of the reactor. The main issue before the board was whether a technical effect was to be recognised linked to the use of the limit value for the effective operation of the nuclear reactor being simulated, even though the claim was not limited to such use. The board observed that the claimed method could be used to establish that a particular reactor fulfilled certain legal requirements, in which case the method would serve an exclusively administrative purpose, and it expressed concern that the claim would be infringed by a programmer implementing it for educational purposes and without actually realising the technical effect (reasons 8.1). Nevertheless, the board adopted the analysis developed in decision T 1227/05 and concluded that the determination of the threshold value contributed to the technical character of the claim (reasons 8.4).

40. Decision T 1842/10 of 30 April 2014 concerned a computer-implemented method for modelling the behaviour of a steel volume with a volumetric surface during a cooling-down process, comprising a step of controlling an "influencing device" such that the steel volume was influenced in accordance with a determined influencing quantity. The deciding board considered the controlling step to confer technical character on the claimed method because in view of that feature the claimed method was directed not to a modelling method having the sole aim of gaining knowledge but to a method of controlling a device for influencing a steel volume

(reasons 4.3). It was, however, still necessary to assess which claim features contributed to the technical character of the method (reasons 4.4). After comparing the claimed method with the closest prior art, the board reasoned that the distinguishing features, all relating to modelling, had technical character because they improved the modelling method and thereby improved the control of the influencing device (operating in connection with a real-world cooling-down process) (reasons 5.2 to 5.4).

41. In decision T 988/12 of 17 July 2018, the deciding board recalled that a computer simulation was essentially the use of a model running on a computer to assess or predict the functioning of a system and stated that it was "difficult to see what technical effect such a process might have", given that the simulation process had no technical effect on the simulated system (reasons 2.3). There was unarguably an effect on the computer running the simulation, but not one that went beyond the normal effects of running software on a computer. The board nevertheless considered the applicability of decision T 1227/05 but came to the conclusion that the simulated system being claimed (a "4G broadband service to be deployed") was not an "adequately defined technical system" (reasons 2.7 and 2.8).

Decisions relating to methods for design

42. Decision T 453/91 has already been discussed above in connection with decision T 1227/05. The board approved the rejection by the examining division of design method claims because the claimed methods could be interpreted as delivering a mere design and the individual steps of designing made no contribution to

the art outside fields of excluded matters, such as performing mental acts and implementing the resulting steps by programs for computers (see reasons 5.2).

43. In decision T 471/05 of 6 February 2007, the method claim under consideration was directed to the design of an optical system in which all light rays imaged between two predetermined points on the system's optical axis satisfied a particular algebraic condition. As the claim merely formulated a series of mathematical and optical abstract concepts without requiring a physical, technical implementation, it encompassed purely abstract and conceptual implementations, including methods for performing mental acts as such, excluded from patent protection under Articles 52(1), (2) and (3) EPC 1973 (reasons 2.1 and 2.2). This remained so even though the claimed method involved conceptual technical considerations concerning optical systems (reasons 2.2). Nevertheless, the addition of the feature "using an optics design program" not only brought the claimed subject-matter out of the exclusions (reasons 4.1), but also sufficed to render it both new and inventive (reasons 4.2 and 4.3). It is apparent from point 4.3 of the reasons that the board considered the features specifying the design process to contribute to the technical character of the invention.

The decision does not explicitly state why the design aspects of the claimed method were considered to make a technical contribution once the feature "using an optics design program" had been added. This was presumably related to the presence in the method of technical considerations relating to optical systems and perhaps also to the fact that the optical system

being designed had particular optical properties as a result of those considerations.

A similar line appears to have been followed in decision T 914/02 of 12 July 2005, which dealt with a method of designing a core loading arrangement for a nuclear reactor. The board characterised the result of the method as a "purely mental, abstract scheme of how bundles could be arranged in an actual, real-world nuclear reactor core, rather than a concrete, physical reactor code loading". Although undoubtedly based on technical considerations, the method could exclusively be carried out mentally and was therefore found to lack technical character. The case was remitted to the department of first instance for further prosecution on the basis of an amended claim that contained the feature "using a suitably programmed computer". (The Board notes, however, that decision T 914/02 does not explicitly state that the amended claim was considered to provide a technical contribution going beyond the mere implementation of the design method on a computer.)

Decision T 887/07 of 23 April 2009 appears to be a third case in this direction. The claim under consideration there was directed to a "knowledge driven composite design optimization system used in designing a laminate part" which generated a "3-D ply definition" for a laminate part. The board noted that Article 52(2) EPC excluded methods for performing mental acts from patentability but that this exclusion did not extend to the claimed system, which represented a technical means for implementing a design optimisation method. The claimed system was found to be both new and inventive, essentially on the basis of the features of the design optimisation method (which itself was not claimed).

44. The independent claim in case T 1567/05 of 30 April 2008 related to a "strength display device" comprising means for constructing and displaying a two-dimensional projection of a virtual three-dimensional model of assembled building structural components and means for computing and displaying stress values for each of the structural components under a plurality of different load conditions. In the closest prior art, stress values were computed, but they were neither computed under a number of different load conditions nor displayed (reasons 3.2). The deciding board considered that the claimed display of information was a non-technical presentation of information because, although relating to technical phenomena, the stress values were mere pieces of information aimed exclusively at the human mind (reasons 3.5). The displayed stress values gave no "visual indications about conditions prevailing in an apparatus or system", as had been held patentable in decision T 115/85 (OJ EPO 1990, 30), since they related to a building structure being designed (reasons 3.7).

45. The invention in case T 1875/07 concerned a computer-implemented method for predicting network traffic on the basis of historical traffic data. The results of the prediction could potentially be used for adapting the hardware resources. The appellant had requested a referral to the Enlarged Board of Appeal of the question "Can the production of data pertaining to and characterizing a technical system have a technical character if the production of the data involves technical considerations relating to the structure of the technical system?" (reasons 7.1).

The deciding board considered that even the most favourable answer to the proposed question could not help the appellant, since the invention did not involve any technical considerations relating to the structure of a technical system (reasons 7.2); some of the considerations underlying the claimed method did imply a certain familiarity with a database structure but not necessarily with any of its technical aspects (reasons 3.3). The alleged effect that hardware resources could be adapted on the basis of the predicted traffic data was not of a technical character, since any re-design of the hardware would be the result of the intellectual effort of a human being analysing the prediction results (reasons 3.4). Since, at most, obvious implementation aspects of the claimed features contributed to the technical character of the invention, the claimed subject-matter lacked inventive step (reasons 3.6).

46. In its decision of 13 December 1999, X ZB 11/98, GRUR 2000, 498 - Logikverifikation (published in English in IIC 2002, 231), the German Federal Supreme Court considered a method for verifying the correct translation of a hierarchical logic plan for a large-scale integrated circuit into a physical layout design. It noted that the claimed method related to an intermediate step in the process of developing and manufacturing silicon chips and, in view of that purpose, formed part of a current technology. The proposed solution was admittedly based on a mental concept, but putting that concept into practice had required technical considerations concerning integrated circuits. The claimed subject-matter was therefore technical. The production of silicon chips was no longer dominated by manufacturing processes that required the direct application of controllable natural

forces; the development and verification of chip designs in a preparatory phase before manufacturing took place was performed nowadays with the help of suitably programmed computers. The development activity of the relevant experts had therefore shifted but still belonged to a technical field and still necessarily involved technical considerations. Patent protection could not be denied just because a proposed solution dispensed with the direct use of controllable natural forces and instead attempted to improve the production of technical building blocks by means of technical knowledge.

The decision represents a turning point in the German Federal Supreme Court's approach to dealing with computer-implemented inventions. It has been criticised for extending patent protection to research and development activities (see e.g. G. Schölch, "Patentschutz für computergestützte Entwurfsmethoden - ein Kulturbruch?", GRUR 2006, 969).

47. In *Halliburton v Smith International* [2005] EWHC 1623 (Pat), the High Court of England and Wales decided on the validity of two European patents, both relating to methods of designing drill bits with the help of a simulation (see paragraphs 3 and 16 of the judgment). The High Court found the claims under consideration, which were "not limited in terms to a computer program, although no doubt [were] so limited as a matter of reality" to be directed purely to the intellectual content of a design process and to the criteria according to which decisions on the way to a design were made and therefore to be firmly within the forbidden region as schemes for performing a mental act, unless "an amendment of the type described in T 0453/91" (i.e. the addition of a step of producing

the designed drill bit) was made (see paragraphs 207 to 218 and 290).

One of these patents was also the subject of decision T 1820/06 of 12 May 2009. The board there considered the claimed method of designing a roller cone bit (which neither included a step of producing the designed bit, nor referred to the use of a computer) to comply with Article 52(2) and (3) EPC because it achieved "a technical effect, i.e. the optimized adjustment of the orientation of at least one tooth on a cone of a roller cone bit" (reasons 4).

48. In *Halliburton v Comptroller-General of Patents* [2011] EWHC 2508 (Pat), the High Court of England and Wales considered a similar method of designing a drill bit with the help of simulation, again not including a step of producing the designed bit (see paragraphs 16 to 18 of the judgment). The High Court construed the claim as being limited to a simulation process carried out on a computer, which meant that the method did not fall within the mental act exclusion (paragraphs 65 and 70). Nor was the invention, being a method of designing a drill bit, a computer program as such or within any of the other exclusions (paragraphs 71 and 72). Since designing drill bits was a highly technical process, capable of being applied industrially, since drill bit designers were highly skilled engineers, and since the problems to be solved with wear and ability to cut rock were technical problems with technical solutions, finding a better way of designing drill bits in general was itself a technical problem (paragraph 74).

Order

For these reasons it is decided that:

The following questions are referred to the Enlarged Board of Appeal for decision:

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?

The Registrar: The Chairman:

I. Aperribay R. Moufang

Decision electronically authenticated