BL O/154/18
9th March 2018

Intellectual Property Office

PATENTS ACT 1977

APPLICANT	Landmark Graphics Corporation
ISSUE	Whether patent application GB1616731.4 complies with section 1(2)
HEARING OFFICER	H Jones

DECISION

Introduction

1 This decision relates to a further application out of a total of sixteen from the same applicant. The sixteen applications have been examined by different examiners and all have concluded that the subject-matter of each of the applications is excluded from patentability under section 1(2) of the Patents Act 1977 ("the Act"), as a computer program in all cases and also as a mathematical method for some. I have already issued decisions relating to fourteen of the applications (BL O/112/18, BL O/138/18, BL O/140/18, BL O/143/18 and BL O/148). This decision concerns the invention set out in GB1616731.4, which relates in general to computer-implemented methods for prospecting, drilling or developing an oilfield by forecasting production data. Despite several rounds of correspondence, the applicant and the examiner have been unable to resolve matters and the issues came before me on 8 and 9 January 2018.

2 As I explained in my earlier decisions, at the hearing the applicant was represented by Mr Alistair Russell and Dr Mark Jones of Hoffmann Eitle who argued that the Office approach in dealing with methods relating to geophysical modelling in these sixteen applications and similar applications refused previously is inconsistent with guidance from the Courts. It remains the case that I am extremely grateful to Mr Russell and Dr Jones for the skeleton arguments provided before the hearing and for their structured presentations on all sixteen of the applications over the course of the two days.

The Law

3 In my earlier decision I dealt with the general approach to assessing patentability under section 1(2) before turning to the seven individual applications. I need not repeat myself here on this general approach and I attach the relevant part of BL O/112/18 as an annex.

4 It is sufficient to say here that I will employ the four step test from *Aerotel*[1], the steps from which are as follows:

[1] Aerotel Ltd v Telco Holdings Ltd and Macrossan's Application [2006] EWCA Civ 1371

(1) properly construe the claim;
(2) identify the actual contribution;
(3) ask whether it falls solely within the excluded subject matter;
(4) check whether the actual or alleged contribution is actually technical in nature.

The application in suit

5 This application was filed as a PCT application on 30 April 2014, published in the international phase as WO2015/167553 and as GB2538918 upon entry into the national phase.

6 The disclosure relates to a method for prospecting drilling or developing an oilfield by forecasting, the forecasting steps being shown in figures 1A, 1B and 1C and described in paragraphs [0022] to [0039] of the specification as filed, reproduced below:

> [0022] Referring now to FIGS. 1A-1C, the flow diagrams illustrate one embodiment of a method 100 for implementing the present disclosure. The method 100 incorporates statistical techniques that can be used to interpret meaningful information from the production data belonging to group of producing wells. The method 100 can identify i) patterns in production data; ii) wells based on production data and rank them; and iii) wells with similar production profiles. The method 100 can also i) relate well production data to well design and completion design parameters and reservoir parameters; ii) improve the forecast of well production data; and iii) replace standard decline curve analysis.
>
> 0023] In step 102, production data is automatically selected for the well(s) of interest or it may be manually selected using the client interface and/or the video interface described further in reference to FIG. 9. In FIG. 2, for example, a graph is used to illustrate actual production data for 34 wells of interest. The production data for each well is represented by a separate line and is plotted on the graph as a function of the production volume in barrels/day per month.
>
> [0024] In step 104, outliers are automatically removed from the production data selected in step 102 or they may be manually removed using the client interface and/or the video interface described further in reference to FIG. 9. Outliers may include, for example, any production data reflecting zero production from wells of interest during times when a well is shut down.
>
> [0025] In step 106, the production data remaining after step 104 is normalized using techniques well known in the art. The production data illustrated in FIG. 2, for example, may be normalized using:
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> $$P_i = \frac{P_{a,i}}{P_{0,i}} \qquad (1)$$
>
> where $P_{a,i}$ is the actual production data, $P_{0,i}$ is a predetermined normalizing factor and P_i is the normalized production data for the ith well (e.g. i=1 to 34). The normalizing factor $P_{0,i}$ can be chosen based on a maximum value or variance of the production data $P_{a,i}$ for each well.
>
> [0026] In step 108, components and corresponding weights in a production

data matrix represented by equation (2) are identified using singular value decomposition and the normalized production data from step 106. The normalized production data P_i for each well from step 106 represents a matrix P in equation (2). Singular value decomposition on matrix P can thus, be represented by: $P = USV^T$ (2) where $P \epsilon \Re^{N \times M}$; N is the number of wells of interest; and M is the number of time steps when production data are reported. $U \epsilon \Re^{N \times N}$, $V \epsilon \Re^{M \times M}$ and $S \epsilon \Re^{N \times M}$ as illustrated by the matrices in FIG. 3. The superscript T stands for transpose of matrix V in equation (2). S is a diagonal matrix defined as:

$$S_{ij} = \begin{Bmatrix} 0 \; if \; i \neq j \; or \; j > N \\ \sigma ij \end{Bmatrix} \qquad (3)$$

where σ_{ii} are also known as Eigen values of matrix P . Each i^{th} column of matrix U and V are represented by u_i and v_i respectively. As illustrated by the matrices in the top row of FIG. 4, the matrices in FIG. 3 can be rearranged by:

$$P = \sum_{i=1}^{N} \sigma_{ii} \, u_i v_i^T \text{ for } i = 1, 2 \ldots N \qquad (4)$$

Singular value decomposition results in σ_{ii} values, which are sorted in decreasing order of their magnitude. Equation (4) suggests that matrix P can be represented by a weighted sum of orthogonal vectors (v_i^T) and these vectors represent the basic components that capture the decline trends of production data. For each component there is corresponding weight factor vector w_i defined by:

$$w_i = \sigma_{ii} u_i \qquad (5)$$

and

$$P = \sum_{i=1}^{N} w_i \, v_i^T \text{ for } i = 1, 2 \ldots N \qquad (6)$$

As illustrated by the matrices in the bottom row of FIG. 4, the matrices in the top row of FIG. 4 can be rewritten by equation (6) wherein the components (v_i^T) and corresponding weights (w_i) are identified in the production data matrix represented by equation (2) using singular value decomposition and the normalized production data from step 106.

[0027] In step 110, a minimum number of components (v_i^T) and corresponding weights (w_i) are automatically identified in the production data matrix from step 108 that are needed to reproduce the normalized production data from step 106 or they may be manually identified using the client interface and/or the video interface described further in reference to FIG. 9. Identification of the minimum number of components (v_i^T) and corresponding weights (w_i) can be accomplished by comparing the distribution of Eigen

values σ_{ii} for matrix P for each of the 34 wells of interest as illustrated in FIG. 5. In this manner, equation (4) can be reasonably approximated by:

$$P \approx \sum_{i=1}^{N} \sigma_{ii}\, u_i v_i^T = \sum_{i=1}^{N} w_i\, v_i^T \text{for } i = 1, 2 \ldots N \tag{7}$$

where n is the minimum number of components (v_i^T) and corresponding weights (w_i). Alternatively, the minimum number of components (v_i^T) and corresponding weights (w_i) may be identified by how many components are required to reproduce the normalized production data P_i from step 106 with a good fit for all wells. The goodness or quality of fit may be predetermined and/or discretionary such as, for example, a 90% fit to actual production data. In FIG. 6, for example, a graph is used to illustrate the fit between the normalized production data (observed) for one of the 34 wells of interest illustrated in FIG. 5 and the approximated production data based on the first two components identified in the production data matrix from step 108. It is clear that even the first component is good enough to capture an acceptable fit. As the second component is added, the fit is improved.

[0028] In step 112, a number for clustering (grouping) the well(s) of interest from step 102 is automatically selected based on a distribution of the well(s) of interest according to the minimum number of components identified in step 110 or the number may be manually selected using the client interface and/or the video interface described further in reference to FIG. 9. In this manner, the well(s) of interest that have a similar production profile may be grouped together. A number for clustering may be selected by the distribution of wells on a two-dimensional or a three-dimensional graph using the weights corresponding to the minimum number of components identified in step 110. In FIG. 7, for example, a two-dimensional graph is used to illustrate the distribution of the same 34 wells of interest illustrated in FIG. 5 according to the minimum number of components and corresponding weights $(w_{i,1}, w_{i,2})$ identified in step 110 ($w_{i,j}$ means weight to jth component for ith well). Although a single cluster may be selected as the number for clustering when small production data sets are used, the example illustrated in FIG. 7 suggests selecting five clusters based on the distribution of wells because there are five groups of wells that appear to have similar production profiles.

[0029] In step 114, the well(s) of interest in step 102 are clustered based on the number selected for clustering in step 112 and the well(s) of interest that have a similar production profile. Clustering may be performed by any well known clustering technique such as, for example, the kernel-k-means technique. In FIG. 8, the same two-dimensional graph illustrated in FIG. 7 is used to illustrate clustering. The same 34 wells of interest illustrated in FIG. 7 are clustered into five separate groups wherein one cluster represents an outlier.

[0030] In step 115, the method 100 determines if there is more than one cluster of wells. If there is not more than one cluster of wells, then the method 100 proceeds to step 120. If there is more than one cluster of wells, then the method 100 proceeds to step 116.

[0031] In step 116, components and corresponding weights in a production data matrix represented by equation (2) are identified for each respective

cluster of wells from step 114 using i) singular value decomposition in the same manner as step 108; and ii) the normalized production data from step 106 for each respective cluster of wells.

[0032] In step 118, a minimum number of components (v_i^T) and corresponding weights (w_i) are automatically identified in each production data matrix from step 116, in the same manner as step 110, that are needed to reproduce the normalized production data from step 106 or they may be manually identified using the client interface and/or the video interface described further in reference to FIG. 9.

[0033] In step 120, the method 100 determines if increased clustering is required. If increased clustering is required, then the method 100 returns to step 112 where a greater number for clustering is selected according to step 112. If increased clustering is not required, then the method 100 proceeds to step 122. To determine if increased clustering is required, the percent (%) variance captured by the first component may be calculated for each cluster and compared to the same for an additional cluster. If, for example, there is no significant increase in the percent (%) variance captured by the first component for five clusters compared to six clusters, then increased clustering is not required. The percent (%) variance captured by the first component is defined by:

$$\text{percent (\%) variance by first component} = \frac{\sigma_{ii}}{\sum_{i=1}^{N} \sigma_{ii}} \qquad (8)$$

[0034] In step 122, any outliers of the well(s) of interest are automatically removed or they may be manually removed using the client interface and/or the video interface described further in reference to FIG. 9. In FIG. 8, for example, there are two wells in a single cluster that are outliers.

[0035] In step 124, a fitted decline curve is calculated for the normalized production data from step 106 for each respective cluster of wells from step 122 using a first component in the minimum number of components identified in step 110 or step 118 for each respective cluster of wells and a standard decline curve. Because the first component will capture most of the production data decline for wells, equation (7) in step 110 may be used with only the first component for each cluster of wells to approximate the normalized production data by:

$$P \approx w_1 v_1^T \qquad 9(a)$$

$$P_i \approx w_{1,i} v_1^T \qquad 9(b)$$

Here, $w_{1,i}$ represents weight factor vector w_i for the ith well for the first component as explained in step 108 for equation (5) for each cluster of wells. For each cluster of wells, the first component $v_1^T(t)$ in the minimum number of components identified in step 110 or step 118 is thus, used as a natural decline curve and a standard decline curve (ϕ) is used to fit the natural decline curve $v_1^T(t)$ by minimizing square mean error to obtain:

$$v_1^T(t) = \phi(t) \qquad (10)$$

The standard decline curve may be any class of well-known hyperbolic curve

or exponential curve.

[0036] In step 126, the method 100 determines whether to forecast production data for any new well(s). If forecasting production data for any new well(s) is required, then the method 100 proceeds to step 130. If forecasting production data for any new well(s) is not required, then the method 100 proceeds to step 128 to forecast production data for the existing well(s).

[0037] In step 128, production data for the existing well(s) in each respective cluster of wells from step 122 is forecast using the product of the fitted decline curve ($\phi(t)$) from step 124 for each respective cluster of wells, the weight $(w_{1,i})$ corresponding to the first component used in step 124 for each respective cluster of wells and the predetermined normalizing factor ($P_{0,i}$) used in step 106 for each well in each respective cluster of wells. The product of these components may be represented as:

$$P_{a,i} \approx P_{0,i} w_{1,i} v_1^T(t) = P_{0,i} w_{1,j} \phi(t) \quad (11)$$

wherein each curve for each cluster of wells can be used for forecasting production data by using future values for time (t) in equation (11). This eliminates well by well curve fitting because the fitted decline curve represented by equation (10) is applicable to all wells belonging to a cluster.

[0038] In step 130, the predetermined normalizing factor ($P_{0,i}$) used in step 106 for each well in each respective cluster of wells from step 122 and predetermined completion parameters for each well in each cluster of wells from step 122 are correlated using the corresponding weights $(w_{1,i})$ from step 110 or step 118 for each well in each cluster of wells. The correlation of these components may be represented as:

$$P_{0,i} w_{1,i} = f(N_f, K, skin) \quad (12)$$

wherein the correlation function (f) could be a linear or nonlinear class of function estimated by standard curve fitting or regression techniques; N_f represents the number of fractures; K represents the permeability; and $skin$ represents a production value. These are just examples of predetermined completion parameters and others, instead of or in addition to, may be used.

[0039] In step 132, production data for new well(s) in each respective cluster of wells from step 122 is forecast using the product of the fitted decline curve (($\phi(t)$) from step 124 for each respective cluster of wells and the correlated completion parameters from step 130 for each well in each respective cluster of wells. The product of these components may be represented as:

$$P_{a,i} = P_{0,i} w_{1,i} \phi(t) = f(N_{f,i}, K_i, skin_i) \phi(t) \quad (13)$$

wherein each curve for each cluster of wells can be used for forecasting production data by using future values for time (t) in equation (12). This eliminates well by well curve fitting because the fitted decline curve represented by equation (10) is applicable to all wells belonging to a cluster.

7 Claim 1 as currently amended reads as follows:

1. A method for prospecting, drilling or developing an oil field by forecasting production data based on normalized production data for a plurality of wells of interest, which comprises:

a) identifying components and corresponding weights in a production data matrix using singular value decomposition, the normalized production data and a computer processor;

b) identifying a minimum number of the components and the corresponding weights in the production data matrix needed to reproduce the normalized production data using the computer processor;

c) determining a number of well clusters based on a distribution of the well(s) of interest according to the minimum number of the components identified in the production data matrix;

d) clustering the well(s) of interest based on the determined number of well clusters and the well(s) of interest that have a similar production profile;

e) identifying components and corresponding weights in a production data matrix for each respective well cluster using singular value decomposition, the normalized production data for each respective well cluster and the computer processor;

f) identifying a minimum number of the components and the corresponding weights in each production data matrix needed to reproduce the normalized production data for each respective well cluster using the computer processor;

g) calculating a fitted decline curve for the normalized production data for each respective well cluster using a first component in the minimum number of components identified for each respective cluster of wells and a standard decline curve; and

h) forecasting production data for one of one or more new and existing wells in each respective well cluster using the fitted decline curve for each respective well cluster.

8 Independent claim 10 is directed to a program carrier device and independent claim 19 is directed to a computer system, but they both relate to the same inventive concept as claim 1 and so I will consider only claim 1.

9 According to the *Aerotel* test I must first properly construe the claim, and claim 1 seems to me to be reasonably clear in the light of the description. I note that the method makes use of normalized production data, i.e. data derived from observation, and that the method is explicitly implemented using a computer processor. I also note that the amended claim is defined in terms of a method of prospecting, drilling or developing an oil field by forecasting production data whereas the original claim was to a method for forecasting production data. The amended claim does not specify precisely (or even generally), what is intended by such prospecting, drilling or development. It seems to me that the applicant has made this amendment in order to tether the claim to a practical use of the forecast outside of the computer, which seems now to be unnecessary in the light of *Halliburton*[2]*.* In any case, I do not believe that it has any material effect on the way I construe the amended claim over

[2] Halliburton Energy Services Inc., [2011] EWHC 2508 (Pat)

the way I construe the original version, i.e. the claim remains in substance a method for forecasting production data.

10 The contribution, according to the examiner, is a computer-implemented method of producing a statistically enhanced prediction of oil well productivity based on the concept of clustering wells according to similar production profiles, therefore producing fitted decline curves based on production data from only the wells with similar characteristics. She adds that the fitted decline curves can be used when forecasting production for existing or new wells in each cluster. Mr Russell and Dr Jones tell me that the contribution is a better computer-implemented process for prospecting, drilling or developing an oil field by forecasting production data based on normalized production data for a plurality of wells, in the sense that the forecasting will tend to be more accurate. While one is more detailed than the other, at their hearts these two formulations of the contribution seem to be much the same save my qualification above that the method, and therefore the contribution, is more properly described as a method of forecasting production data.

11 Based on this contribution, has the invention added no more to human knowledge than a computer program as such? In other words, is the contribution technical? Mr Russell and Dr Jones explained that production data in this context represents the amount of oil that can be drawn out of the terrain over time and that it represents a physical value associated with the geology, not an economic one. While it is perhaps not quite as clear as in some of the other sixteen applications, I view the production data at the start of the process as akin to a model (albeit with fewer points of reference than a three dimensional earth model), which production data or model is then manipulated by the steps of identifying components and corresponding weights (steps a), b), e) and f)) and the step of clustering wells, and is then used for calculating a fitted decline curve used in forecasting production data. Although undoubtedly computer-implemented, I do not believe that the method is simply a computer program as such. The method uses real data and something akin to the object discussed in *Vicom*[3] and all this is done in what Mr Russell and Dr Jones were keen to explain is very much a technical field of endeavour, in line with *Halliburton*.

Conclusion

12 I find that the invention in GB1616731.4 is not excluded by section 1(2) as a program for a computer as such. I will however refer the application back to the examiner for further examination. This is because I believe that the search may need to be updated.

H JONES
Deputy Director, acting for the Comptroller

[3] Vicom T 0208/84

Annex - Discussion of the law taken from BL O/112/18

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The Law

4 Section 1(2) of the Act lists certain categories of subject-matter which are not considered to be inventions. These categories of subject-matter are conventionally known as excluded subject-matter:

> *1(2). It is hereby declared that the following (among other things) are not inventions for the purposes of this Act, that is to say, anything which consists of –*
>
> *(a) a discovery, scientific theory or mathematical method;*
> *(b) a literary, dramatic, musical or artistic work or any other aesthetic creation whatsoever;*
> *(c) a scheme, rule or method for performing a mental act, playing a game or doing business, or a program for a computer;*
> *(d) the presentation of information;*
>
> *but the foregoing provision shall prevent anything from being treated as an invention for the purposes of this Act only to the extent that a patent or application for a patent relates to that thing as such.*

5 The Court of Appeal in *Symbian*[4] stated that the question of whether a computer-implemented invention is patentable has to be resolved by answering the question whether it reveals a technical contribution to the state of the art. It proceeded to answer the question with the aid of the four-step test set out in its earlier judgment in *Aerotel*[5], the fourth step of this test being to check whether the contribution is technical in nature. In paragraph 46 of *Aerotel* it is stated that applying this fourth step may not be necessary because the third step should have covered the question. This is because a contribution which consists solely of excluded matter will not count as being a "technical contribution" and thus will not, as the fourth step puts it, be "technical in nature".

6 Mr Russell and Dr Jones sought to persuade me how each of the seven applications before me provide the necessary technical contribution. In discussing the general approach to assessing patentability, Mr Russell and Dr Jones in essence had two points to make. The first concerned the appropriate standard of proof that an applicant should meet and the second point concerned the proper application of tests for patentability and especially the consideration of technical contribution. I shall deal with each point in turn.

Standard of proof

7 According to Mr Russell and Dr Jones, once an examiner has raised an objection to an application and the applicant has responded with argument and/or amendment then the examiner should give the applicant the benefit of the doubt and consider the objection overcome, unless there can be no doubt on the matter. While this is offered as a general proposition, in this decision I am particularly considering objections raised under section 1(2). In this regard Mr Russell and Dr Jones took me to a

[4] Symbian Ltd. v Comptroller-General of Patents [2008] EWCA Civ 1066
[5] Aerotel Ltd v Telco Holdings Ltd and Macrossan's Application [2006] EWCA Civ 1371

passage in *Macrossan v Comptroller-General of Patents ("Macrossan")*[6] (at paragraphs 7 and 8) in which *Fujitsu Ltd's Application*[7] is quoted by the Appellant before Mann J; the passage from *Fujitsu* is as follows (paragraph 533):

> *"In coming to that conclusion [*viz a conclusion against validity*] I have borne in mind that, prima facie, a novel technical development should be patentable and that section 1(2) contains a list of exceptions to such patentability. Therefore, the onus lies on the person contesting patentability to prove that the invention falls foul of the statutory exclusions. Furthermore, at the patent office stage, benefit of the doubt should be given to the applicant. Refusal of the grant on the basis of a faulty appreciation of what is involved cannot thereafter be remedied."*

8 Mann J goes on to say at paragraph 9 of *Macrossan*:

> *"Mr Birss, in his written submissions for the Comptroller, points out that Whitford J was not addressing a question of principle in what he said. I agree with that, but his statement nonetheless seems to reflect a principle or principles which are consistent with what Laddie J said in Fujitsu. That principle seems to involve the onus being on the person alleging that the alleged invention is within the exclusion. The reference to the benefit of the doubt is probably intended to signify that if there is substantial doubt then the burden has not been fulfilled. I do not consider that it means that if there is any doubt (legal or factual) then the application should succeed. It is not intended to import something like the criminal burden of proof into the proceedings. The tribunal still has to consider whether the exception applies, and it can come to the conclusion that it does without having to find that there is no doubt at all about it."*

9 The current practice of the Office in this regard is set out in paragraph 1.10 of the Manual of Patent Practice, as follows:

> *"The Court of Appeal, in paragraph 5 of Aerotel Ltd v Telco Holdings Ltd & Ors Rev 1 [2007] RPC 7 (Aerotel/Macrossan), made it clear that assessing excluded matter involves a question of law which should be decided during prosecution of the patent application. The position is therefore assessed fully by patent examiners before grant, and objections are not to be dropped simply because the applicant asserts that the invention relates to non-excluded subject matter. The question of excluded matter is decided on the balance of probabilities, taking into account all of the evidence available. However, as it is a question of law, it is not something on which applicants are entitled to the benefit of the doubt, in the way they would be in relation to questions of pure fact (such as the date of a particular disclosure, or the scope of the common general knowledge)."*

10 The original passage in question from the Court of Appeal is this:

> *"In that connection we should record also that we accept Mr Birss' submission that any pure question of law involved should be decided during prosecution. It is not enough to get a patent past the application stage to show that as a matter of law it merely arguably covers patentable subject-matter. The position is different from that under the old law. Then the rule was that patents should be refused only where on no reasonable view could the subject-matter be patentable, see Swift's & Co Application [1962] R.P.C. 37 at 46. Despite that being the rule, in the years that followed Swift, in practice a decision of the Office or on appeal to the Appeal Tribunal was taken to decide the matter once-and-for all. That itself shows there is no point doing other than deciding the question. Moreover that is what the European Patent Office (EPO) does and there is no warrant in the EPC for the "arguable" approach. Of course if a debatable question of pure fact is or may be involved at the application stage, things are different-one cannot then say that the*

[6] Macrossan v Comptroller-General of Patents [2006] EWHC 705 (Ch)
[7] Fujitsu Ltd's Application [1996] RPC 511

decision at that point must be the last word on the subject. Then the applicant must be given the benefit of any reasonable doubt."

11 From the references to prosecution and application stage I take it that the quote from the Court of Appeal is relevant to the practice of the Office.

12 It seems therefore that there is a burden upon an examiner to demonstrate that an invention falls foul of the exclusions and that to overcome such an objection an applicant must do more than "show that … it merely arguably covers patentable subject-matter". In other words, both the examiner and the applicant must do much more than simply assert that their view is correct.

13 Mr Russell and Dr Jones say in their skeleton arguments that they are not seeking to create false or spurious doubt about whether the inventions in each of the applications are excluded, since it is clear from the case law cited above that this would not be enough to cause an application to succeed. However, they say that the arguments advanced in respect of each of the applications are sufficient to create real and substantial doubt as to whether the inventions are excluded, and they suggest that the Office should only maintain an objection when it is clear that the applicant cannot be right.

14 Crucial to the test set out in *Aerotel* is the step of identifying the contribution, and it is the position of Mr Russell and Dr Jones that examiners have assessed the contribution in the present applications (and others before them) far too narrowly and have been unprepared to question their initial assessment or to consider whether it is possible that the applicant's assessment of the contribution may indeed be right. By way of illustration they asked me to consider the general case of a method that:

> i) uses a computer to read in geological data,
> ii) carries out a sequence of mathematical operations with the computer to create a model of the geological formation, and
> iii) carries out a sequence of mathematical operations with the computer on the model of the geological formation.

15 They argue that such a method is not a mathematical method in the sense of section 1(2) because the claim is to the application of mathematical steps to geological modelling. If there is any doubt about this then they say that the benefit of such doubt has to go with the applicant. It is similarly argued that the use of real data takes the method outside the computer program exclusion and that the steps of creating and manipulating a model create and then change a tangible technical entity which also take the method outside the computer program exclusion. Again, any doubt about this should be resolved in favour of the applicant.

16 I do not think that the arguments advanced in relation to this hypothetical example help clarify the standard of proof required of examiners in objecting to inventions relating to excluded subject-matter. However, I will return to these general arguments when considering the technical contribution in each of the applications before me.

17 Mr Russell and Dr Jones suggest that an applicant should be given the benefit of the doubt unless there is no reasonable doubt to be had. Insofar as this reasonable doubt is the same as the substantial doubt to which Mann J refers, I can agree with this principle. I consider that the question for me is whether or not there is such substantial doubt regarding each of these seven applications, such that where an

applicant makes a reasonable case that their invention is patentable then I am bound to find in their favour. I shall proceed on this basis.

Assessment of the contribution

18 The four steps in the *Aerotel* test which I referred to earlier are as follows:

> (1) properly construe the claim;
> (2) identify the actual contribution;
> (3) ask whether it falls solely within the excluded subject matter;
> (4) check whether the actual or alleged contribution is actually technical in nature.

19 Mr Russell and Dr Jones say that the question of how to identify the contribution in the second step of this test is critical and referred me to the following paragraphs in *Aerotel* for guidance:

> *"43.The second step – identify the contribution - is said to be more problematical. How do you assess the contribution? Mr Birss submits the test is workable – it is an exercise in judgment probably involving the problem said to be solved, how the invention works, what its advantages are. What has the inventor really added to human knowledge perhaps best sums up the exercise. The formulation involves looking at substance not form – which is surely what the legislator intended.*
>
> *44. Mr Birss added the words "or alleged contribution" in his formulation of the second step. That will do at the application stage – where the Office must generally perforce accept what the inventor says is his contribution. It cannot actually be conclusive, however. If an inventor claims a computer when programmed with his new program, it will not assist him if he alleges wrongly that he has invented the computer itself, even if he specifies all the detailed elements of a computer in his claim. In the end the test must be what contribution has actually been made, not what the inventor says he has made."*

20 They referred me to paragraphs 37 and 53-54 of S*ymbian* as evidence of how the Office's approach to identifying the contribution made by inventions of the kind set out in the present applications is too narrow and is resulting in decisions by the Office to refuse applications that would otherwise be allowed by the Courts. Paragraphs 50-52 are also worth referencing as context to the subsequent paragraphs:

> *"37. The right starting point is the decision of the Board in Vicom/Computer-related invention T0208/84, [1987] 2 EPOR 74. At [3], the Board said that:*
>
> *"a method for obtaining and/or reproducing an image of a physical object or even an image of a simulated object (as in computer-aided design/computer-aided manufacturing … systems) may be used e.g. in investigating properties of the object or designing an industrial article and is therefore susceptible of industrial application. Similarly a method for enhancing or restoring such an image, without adding to its informational content, has to be considered as susceptible of industrial application" and hence would not be excluded from patentability.*
>
> *At [12]:*
>
> *"a claim directed to a technical process which process is carried out under the control of a program (… in hardware or in software) cannot be regarded as relating to a computer program as such …, as it is the application of the program for determining the sequence of steps in the process for which in effect protection is sought".*
>
> *At [15]:*

"Generally claims which can be considered as being directed to a computer set up to operate in accordance with a specified program (whether by means of hardware or software) for controlling a technical process cannot be regarded as relating to a computer program as such … ."

Finally at [16] the Board described "making a distinction between embodiments of the same invention carried out in hardware or in software" as "inappropriate", as what is "decisive" is the "technical contribution which the invention described in the claim when considered as a whole makes to the known art".

50. The fact that "the boundary line between what is and what is not a technical [contribution]" is imprecise (as Nicholls LJ said in Gale, and as was echoed by Aldous LJ in Fujitsu) may be attributable to three causes, which are not mutually exclusive. First, national tribunals and the Board may still be at an intermediate stage of working out and identifying the precise location of that line; secondly, the problem may be inherent and never wholly satisfactorily soluble; thirdly, there are competing views based on different philosophies (the "open source movement represents one extreme, that of companies such as the present applicant, the other). The uncertainty is well demonstrated by the elusiveness of the meaning of "technical", the change of attitude manifested in the more recent decisions of the Board, the contrasting outcomes in Vicom and Fujitsu, and indeed the possible reconsideration of the correct view of computer program patents in the United States (see Professor John Duffy: Death of Google's Patents? Patently-O Patent Law Blog, July 21st, 2008).

51. These considerations reinforce our view that, at least in this court at this stage, we should try to follow previous authority, we should seek to steer a relatively unadventurous and uncontroversial course, and we should be particularly concerned to minimise complexity and uncertainty. These aims are not necessarily mutually consistent, but, on this occasion, we believe they are achievable, namely by following the analysis adopted by the Board in Vicom and the two IBM Corp. cases, and of the Court of Appeal in Merrill Lynch and Gale.

52. These considerations also manifest the difficulty of formulating a precise test for deciding whether a computer program is excluded from patentability, and suggest that it could be inappropriate to accept either of the rival simple propositions (summarised at [17] above) advanced by the parties here. Bearing in mind the multifarious features of computer programs and the unpredictable developments which will no doubt occur in the IT field, we believe that it would also be dangerous to suggest that there is a clear rule available to determine whether or not a program is excluded by art 52(2)(c). Each case must be determined by reference to its particular facts and features, bearing in mind the guidance given in the decisions mentioned in the previous paragraph.

53. Based on these principles, we consider that Patten J was right and that the claimed invention does make a technical contribution, and is not therefore precluded from registration by art 52(2)(c). To start with a defensive point, the program in this case does not embody any of the items specifically excluded by the other categories in art 52; thus, it is not a method of doing business (as in Merrill Lynch), or a mathematical method (as in Gale), or a method for performing mental acts (as was probably the case in Fujitsu).

54. More positively, not only will a computer containing the instructions in question "be a better computer", as in Gale, but, unlike in that case, it can also be said that the instructions "solve a 'technical' problem lying with the computer itself". Indeed, the effect of the instant alleged invention is not merely within the computer programmed with the relevant instructions. The beneficial consequences of those instructions will feed into the cameras and other devices and products, which, as mentioned at [3] above, include such computer systems. Further, the fact that the improvement may be to software programmed into the computer rather than hardware forming part of the computer cannot make a difference – see Vicom; indeed the point was also made by Fox LJ in Merrill Lynch.

21 Mr Russell and Dr Jones note that the European Patent Office Technical Board of Appeal's decision in *Vicom*[8] was approved by the Court of Appeal in *Aerotel* and *Symbian.* They suggest that it is hard to conceive of a case that could be closer to the issues under consideration in the present application and say that *Vicom* points to the fact that the inventions in the seven applications before me are technical and do not lie in excluded subject-matter as such. They say that for the Office to find differently suggests that its approach to assessing contribution must be wrong.

22 So what then is the correct approach to assessing the contribution? In his second sentence in paragraph 44 of *Aerotel* (quoted above), Jacob LJ refers to the Office accepting the word of the inventor with regard to the contribution made, however it is not clear whether the qualification that follows, i.e. "It cannot actually be conclusive", is also intended to apply to the Office. Paragraph 1.20 of the Manual of Patent Practice appears at first glance to be helpful in this respect in that it takes me to paragraphs 23-24 in *IGT/Acres Gaming Inc*[9]*,* where Mr Peter Prescott QC (sitting as Deputy Judge) addresses this general issue:

> *"23. After hearing argument in this case I wondered what is meant by the second paragraph I have quoted, namely paragraph 44. Does it mean that the Patent Office is bound to accept the applicant's assertion (save in blatant cases)? Or can the Patent Office do a prior art search to find out what has the inventor really added to human knowledge? I therefore invited further submissions in writing.*
>
> *24. Although there was some disagreement, both parties accepted that the Patent Office is entitled to do a prior art search and that if it turns out that the alleged contribution was already known, or was obvious, there can hardly be a contribution to human knowledge. In my judgment that is correct. And there will be no patentable contribution to human knowledge if what is new and not obvious relates solely to a business method as such."*

23 What Mr Prescott appears to be saying here is that if the alleged contribution is either known or obvious such that the claimed invention adds nothing to human knowledge (per *Aerotel*), then the application can be refused under section 1(2). Although Mr Russell and Dr Jones did not address me directly on this case, they did address the general point that the correct basis for refusing an application in this situation would be for lack of novelty or inventive step and not under section 1(2), which is the approach, they say, that the European Patent Office takes.

24 Mr Russell and Dr Jones suggested that I need only look at how the Courts have approached the assessment of "actual contribution" to see how the Office approach is inconsistent. In the Patents Court judgment in *Halliburton Energy Services Inc. ("Halliburton")*[10]*,* in which HHJ Birss QC (as he then was, and sitting as a judge of the High Court) heard an appeal of an Office decision[11] to refuse various applications relating to the use of a computer simulation to improve the design of roller cone drill bits for drilling oil wells, the actual contribution made by the invention was addressed as follows (paragraphs 66 and 67 of *Halliburton*):

> *"66.Mr Thorpe identified the contribution made by this invention in paragraph 29. He said:*
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> *29. I will leave for a moment the issue of whether outputting the results to a resource*

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[8] Vicom T 0208/84
[9] IGT/Acres Gaming Inc, Re [2008] EWHC 568 (Pat)
[10] Halliburton Energy Services Inc., [2011] EWHC 2508 (Pat)
[11] BL O/080/11

adds to the contribution. For the moment I am happy to proceed on the basis of a slightly broader interpretation of what Mr Davis has proposed. The contribution of the claimed invention is in my view, as a matter of substance:

A method of designing drill bits that includes simulation of the performance of the drill bit based on calculating a three dimensional mesh for each cutting element and for the earth formation and using that to determine the forces acting on each mesh segment of the cutting element and then the forces and stresses acting on each cutting element.

67. I agree with that statement save that it seems to me to be important to state that the contribution is a computer implemented method of designing drill bits. Normally that emphasis would not be very important, for example if the case was concerned with the business method exclusion it would be irrelevant, but in this case, given the debate about the mental act exclusion, it is critical."

25 At paragraph 67, HHJ Birss agrees with the Hearing Officer's assessment of the actual contribution but considered it important to emphasise that the method of designing drill bits was limited to implementation on a computer, i.e. the contribution was a "computer-implemented method of designing drill bits". Having identified the actual contribution, the Hearing Officer went on to consider whether the contribution fell within excluded subject-matter and felt bound to follow the conclusion reached previously by Pumfrey J in *Halliburton v Smith ("Smith")*[12] given the similarity of the inventions. The Hearing Officer refused the applications on the basis that the "untethered" inventions were mental acts. However, HHJ Birss said that the Hearing Officer had taken too broad a view of the mental act exclusion and had misinterpreted the way in which Pumfrey J had applied the exclusion in *Smith* - the claims in *Smith* encompassed acts that could be performed mentally whereas the claims in *Halliburton*, which included steps of simulation and outputting, tied the method to implementation on a computer and therefore could not be performed mentally. He says at paragraph 77 of *Halliburton* that *"His concern [i.e. Pumfrey J] was not with the technical contribution as a matter of substance – which he did not doubt – but with the form of the claims."* The Hearing Officer had understood from *Smith* that a "tethering step", i.e. the subsequent manufacture of the drill bit, was needed to avoid the mental act exclusion and for a technical contribution to be made, but HHJ Birss said that this was incorrect.

26 When it came to the step of assessing whether the contribution fell solely within excluded subject matter, i.e. the third step of the *Aerotel* test, HHJ Birss says at paragraph 71 that the contribution is a method of designing a drill bit and therefore more than a computer program as such. Here he relied upon a more general description of the contribution than the narrower version formulated by the Hearing Officer. When checking whether the contribution is actually technical in nature, i.e. the fourth step of the *Aerotel* test, HHJ Birss says at paragraph 74 that *"designing drill bits is obviously a highly technical process, capable of being applied industrially……The detailed problems to be solved with wear and ability to cut rock and so on are technical problems with technical solutions"*, concluding that the applications did satisfy the requirements of section 1(2). Here again he relies upon a more general description of the contribution, his conclusion on whether the more general description of the contribution is actually technical in nature echoing his comments earlier in the judgment (at paragraphs 29-38) after reviewing the

[12] Halliburton Energy Services, Inc. v Smith International (North Sea) Ltd & Ors [2005] EWHC 1623 (Pat) (21 July 2005)

judgments in *Merrill Lynch*[13], *Gale*[14], *Macrossan*, *Aerotel*, *Symbian*, etc.. Paragraph 38 says:

> *"38. What if the task performed by the program represents something specific and external to the computer and does not fall within one of the excluded areas? Although it is clear that that is not the end of the enquiry, in my judgment that circumstance is likely to indicate that the invention is patentable. Put in other language, when the task carried out by the computer program is not itself something within the excluded categories then it is likely that the technical contribution has been revealed and thus the invention is patentable. I emphasise the word "likely" rather than "necessarily" because there are no doubt cases in which the task carried out is not within the excluded areas but nevertheless there is no technical contribution at all."*

27 Even though it seems that the applicant, Halliburton, may not have been the first to invent a computer-implemented method for designing drill bits *per se*, it seems from this judgment that one can take a step back from the actual advance over the state of the art when assessing the contribution for the purpose of section 1(2) and simply identify the field of endeavour in which the method is applied. In other words, it might not be necessary to conduct a forensic analysis of the difference between the invention and the prior art in order to assess what the inventor has really added to human knowledge when it is clear that the invention is limited to a very specific task or application that is not itself excluded. The fact that one can specify precisely the difference between the invention and the state of the art within a description of the actual contribution does not alter the fact that a contribution is also made within a general field of endeavour if the invention is claimed and limited in such a way. If that field of endeavour is a technical one then, according to *Halliburton,* there is a reasonable chance of it being a patentable invention under section 1(2). For computer-implemented inventions such as the ones in *Halliburton* and *Vicom*, it can be sufficient to determine whether the general task performed by the computer program is external to the computer and does not fall within one of the excluded areas in order to conclude that a technical contribution has been revealed. For other computer-implemented inventions, where the task performed by the program is limited entirely to what is going on inside the computer, an invention can be patentable if it solves a technical problem relating to the running of computers generally.

28 This poses an interesting question in respect of the assessment of contribution as determined in *Halliburton.* Given that HHJ Birss agreed with the narrow description of the contribution identified by the Hearing Officer but then relied upon a more general description of it when assessing steps 3 and 4, would HHJ Birss have come to a different conclusion on the question of patentability had he proceeded on the same narrow basis as the Hearing Officer? In other words, was the reason that a different conclusion was reached by the Hearing Officer a direct consequence of having taken a narrower view of the contribution, which Mr Russell and Dr Jones suggest is the practice of the Office, or simply because he came to a different view of what is technical.

29 On reading the Hearing Officer's decision it seems clear that the latter was the case, However, I shall first set our Mr Russell and Dr Jones' argument as to how a narrow view of the contribution can lead to inconsistencies in deciding what is and isn't a

[13] Merrill Lynch's Application, [1989] RPC 561
[14] Gale's Application [1991] RPC 305

patentable invention before I explain my reasons why. They sought to illustrate their argument by way of example. In an invention where the only difference between a known method of processing particular data sets, e.g. a method for enhancing/modelling image or geophysical data, is the use of a Fast Fourier Transform (FFT) instead of a Fourier Transform (FT), the benefits of doing so being to reduce the processing load of the computer, a narrow assessment of the contribution could lead to a conclusion that what has been added to human knowledge is the mere replacement of a FT with an FFT, and a mistaken assessment that this is nothing more than a mathematical or computational advance. They say that such a narrow approach would be wrong, because the invention remains a method for enhancing/modelling image or geophysical data, which is inherently patentable (per *Vicom*). Once past the hurdle of section 1(2), they say that the act of replacing the FT with an FFT should then be assessed against the requirement for inventive step, this being the proper place for doing so and not confused with any consideration of whether the invention is within the list of exclusions set out in section 1(2)

30 I accept Mr Russell's and Dr Jones' point that there is a risk of reaching the wrong conclusion on section 1(2) if the contribution is not properly framed. However, as I have said, I do not believe that the reason the Hearing Officer came to a different conclusion to that of the Court in *Halliburton* was a consequence of having relied upon a much narrower description of the contribution in assessing steps 3 and 4 – the Hearing Officer had simply applied the mental act exclusion on too broad a basis.

31 So where does this leave me with regard to the correct approach to assessing the contribution? It seems to me from *Halliburton* that it is quite possible to arrive at either a narrow or a broad view of the actual contribution made by the invention and still be able to come to the same conclusion as to whether the contribution falls solely within excluded subject-matter. I have already noted that HHJ Birss agreed with the narrow form of the contribution set out by the Hearing Officer in *Halliburton* while also relying on a broader description when assessing whether the contribution was technical. The reason for doing so seems clear, in that it allowed him to quickly highlight the nature of the task performed by the computer program as representing something specific and external to the computer, i.e. designing drill bits. This task was included in both the narrow and broad descriptions of the contribution, and illustrated how the computer program was tied to a specific field of endeavour. He then goes on to consider whether the contribution is technical, saying that when the task is not something within the excluded categories then it is likely that that the technical contribution has been revealed and that the invention is patentable. He emphasises the word "likely" rather than "necessarily" because there would no doubt be cases in which the task carried out is not within the excluded areas but nevertheless there is no technical contribution at all.

32 It is precisely this approach I intend taking in this decision: when assessing the actual contribution in a computer-implemented invention, I shall take proper account of the task performed by the computer and determine whether the task falls outside the excluded categories. I shall also take account of Mr Russell and Dr Jones' argument that such cases, i.e. the cases in which the task carried out is outside the excluded areas but nevertheless there is no technical contribution at all, would be the exception rather than the norm. If the task carried out is within an excluded area, e.g. a computer program, then HHJ Birss explains at paragraph 37 of *Halliburton* that this is not necessarily the end of the matter because a program that solves a technical

problem relating to the running of computers generally is not excluded by section 1(2). The oft-quoted signposts in *AT&T/CVON*[15] provide a useful summary of where the Courts have identified a technical contribution in computer-implemented inventions when the task carried out falls within an excluded category, but there are likely to be other areas where a technical contribution is found that have not yet been considered by the Courts.

The applications in suit

33 Before addressing each application in turn, Mr Russell and Dr Jones made some general comments regarding the set of applications I am to consider and the field of endeavour in which they lie.

34 A parallel is drawn between the geological models in these applications and an image that is manipulated as in *Vicom,* and a quote is taken from the Reasons for the Decision in *Vicom*:

> *5. There can be little doubt that any processing operation on an electric signal can be described in mathematical terms. The characteristic of a filter, for example, can be expressed in terms of a mathematical formula. 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.*

35 Mr Russell and Dr Jones reminded me that a similar point was put to me in a previous hearing concerning a method of processing seismic or other geophysical data, namely *WesternGeco Ltd's Application*[16]*.* In that case I agreed "*that Vicom was particularly relevant to the present application because of the similarity in the subject matter of the two inventions*" and I agree that the same is true with the present applications. In *WesternGeco* my decision was that some, but not all, of the claims related to subject matter excluded from patentability under section 1(2), namely the "untethered" claims that did not include a step of determining one or more parameters relating to physical properties of the earth's interior from the processed geophysical data. I came to the same conclusion as the Hearing Officer in *Halliburton* that a tethering step was necessary to make a method of processing seismic data patentable, i.e. technical, which the Court has since found to be incorrect. To the extent that Mr Russell and Dr Jones wish me to draw general conclusions regarding patent applications relating to methods involving geological models, all that I can say is that such methods are not inherently excluded from patentability and that such an invention must be considered upon its own merits.

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[15] AT&T Knowledge Ventures LP, Re [2009] EWHC 343 (Pat)
[16] BL O/135/07