TOPIC: J–00   Meaning of Art
           J–50   Mere Plan

SUJET: J–00   Signification de la
                   technique
           J–50   Simple plan

Application No. : 2635393
Demande nº 2635393

IN THE CANADIAN PATENT OFFICE

DECISION OF THE COMMISSIONER OF PATENTS

Patent application number 2635393, having been rejected under subsection 30(3) of the *Patent Rules* (SOR/96–423) as they read immediately before October 30, 2019, refused under section 40 of the *Patent Act* and then having had that refusal set aside after appeal to the Federal Court under section 41 of the *Patent Act*, has subsequently been reviewed according to the direction of *Choueifaty v Canada (AG)* 2020 FC 837. The recommendation of the Patent Appeal Board and the decision of the Commissioner are that the application be allowed only if specific necessary amendments are made.

Agent for the Applicant:

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INTRODUCTION

[1]   This recommendation concerns the review of rejected patent application number 2635393, which is entitled "Methods and systems for providing an anti-benchmark portfolio" and is owned by Mr. Yves Choueifaty. The outstanding defect indicated by the Final Action (FA) is that the claims do not define statutory subject matter, contrary to section 2 of the *Patent Act*. The Patent Appeal Board (the Board) has reviewed the rejected application according to the instructions of the Federal Court in *Choueifaty v Canada (AG)* 2020 FC 837 [*Choueifaty*]. As explained below, our recommendation is to inform the Applicant by notice pursuant to subsection 86(11) of the *Patent Rules* that certain amendments to the claims are necessary to make the application allowable.

BACKGROUND

The application

[2]   Canadian patent application 2635393 was filed on June 19, 2008 and has been open to public inspection since December 22, 2008.

[3]   The invention relates to the provision of an "anti-benchmark portfolio." That is, it relates to the selection and management of a portfolio of securities such that it usually has a better expected return and lower expected volatility than a given portfolio or benchmark for the same universe of securities. The anti-benchmark approach is intended to maximize diversification within a given universe of securities.

Prosecution history

[4]   On January 28, 2016, the FA was issued pursuant to subsection 30(4) of the *Patent Rules* (SOR/96–423) as they read immediately before October 30, 2019. The FA indicated the application to be defective on the ground that claims 1 to 27 on file encompass subject matter outside the definition of invention and thus do not comply with section 2 of the *Patent Act*.

[5]   In its July 28, 2016 response to the FA (RFA), the Applicant submitted arguments for allowance and proposed a first amended set of 27 claims.

[6]   The Examiner neither considered that the amendment would remedy the defect nor was persuaded by the Applicant's arguments to withdraw the rejection. Accordingly, the application was referred to the Board for review of the issue on behalf of the Commissioner of Patents.

[7]   During that review, on October 1, 2018, the Applicant made submissions, including a proposed amended set of 63 claims (the second proposed claims) and an affidavit from Mr. Tristan Froidure, Head of Research at Mr. Choueifaty's investment management firm, TOBAM (the Froidure affidavit). At the conclusion of its review, the Board recommended to the Commissioner that the application be refused. The Commissioner did so and issued her decision: *Re Choueifaty's Patent Application 2635393* (2019), CD 1478 (Pat App Bd & Pat Commr) [*CD 1478*].

[8]   The Applicant appealed this decision and the Federal Court ultimately set it aside in *Choueifaty*, directing the Commissioner "to consider the [2635393] Application afresh based on the Second Proposed Claims submitted by the Appellant and in accordance with these reasons."

[9]   A new Panel of the Board was formed to assist the Commissioner with her reconsideration of the application and to make a recommendation as to its disposition. We have considered this application based on the second proposed claims and in accordance with the instructions and reasons of the Federal Court in *Choueifaty*. We have also reviewed the FA and the other correspondence between the Applicant and the Examiner.

ISSUE

[10]   The issue addressed by this review is whether the second proposed claims define subject matter falling within the definition of invention in section 2 of the *Patent Act*.

LEGAL PRINCIPLES AND PATENT OFFICE PRACTICE

Purposive construction

[11]   *Choueifaty* (at paras 31–40) emphasizes the importance of, when determining whether claimed elements are essential or non-essential, following the principles of purposive

construction set out in *Free World Trust v Électro Santé Inc*, 2000 SCC 66 [*Free World Trust*] and *Whirlpool Corp v Camco Inc*, 2000 SCC 67 [*Whirlpool*].

[12] In accordance with *Free World Trust*, essential elements are identified through a purposive construction of the claims done by considering the whole of the disclosure, including the specification and drawings (see also *Whirlpool* at paras 49(f) and (g), and 52). Whether or not an element is essential depends both on the intent expressed in or inferred from the claim, and on whether it would have been obvious to the skilled person that a variant has a material effect upon the way the invention works (*Free World Trust* at paras 55, 57, 59).

[13] "Patentable subject matter under the *Patent Act*" (CIPO, November 2020) [*PN2020–04*], drafted in response to *Choueifaty*, also discusses the application of these principles:

> The purposive construction of a claim is carried out in light of the whole of the specification and takes into account what the person skilled in the art would understand from the whole of the specification to be the nature of the invention.

> During purposive construction of a claim, the elements of the claimed invention "are identified as either essential elements (where substitution of another element or omission takes the device outside the monopoly) or non-essential elements (where substitution or omission is not necessarily fatal to an allegation of infringement)." In carrying out this identification of essential and non-essential elements, all elements set out in a claim are presumed essential, unless it is established otherwise or is contrary to the language used in the claim.

[14] Since the purposive construction of a claim takes into account what the skilled person would understand to be the nature of the invention, it is necessary to identify the skilled person and their relevant common general knowledge (CGK).

Patentable subject matter

[15] The definition of invention is set out in section 2 of the *Patent Act*:

> **invention** means any new and useful art, process, machine, manufacture or composition of matter, or any new and useful improvement in any art, process, machine, manufacture or composition of matter.

[16] Subsection 27(8) of the *Patent Act* also prescribes that:

No patent shall be granted for any mere scientific principle or abstract theorem.

[17]   *PN2020–04* explains the Patent Office's approach to determining if a computer-related invention is patentable subject matter:

> To be both patentable subject-matter and not be prohibited under subsection 27(8) of the *Patent Act*, the subject-matter defined by a claim must be limited to or narrower than an actual invention that either has physical existence or manifests a discernible physical effect or change and that relates to the manual or productive arts, meaning those arts involving or concerned with applied and industrial sciences as distinguished in particular from the fine arts or works of art that are inventive only in an artistic or aesthetic sense.
>
> …
>
> The mere fact that a computer is identified to be an essential element of a claimed invention for the purpose of determining the fences of the monopoly under purposive construction does not necessarily mean that the subject-matter defined by the claim is patentable subject-matter and outside of the prohibition under subsection 27(8) of the *Patent Act*.
>
> …
>
> If a computer is merely used in a well-known manner, the use of the computer will not be sufficient to render the disembodied idea, scientific principle or abstract theorem patentable subject-matter and outside the prohibition under subsection 27(8) of the *Patent Act*.
>
> In the case of a claim to a computer programmed to run a mathematical algorithm, if the computer merely processes the algorithm in a well-known manner and the processing of the algorithm on the computer does not solve any problem in the functioning of the computer, the computer and the algorithm do not form part of a single actual invention that solves a problem related to the manual or productive arts. If the algorithm by itself is considered to be the actual invention, the subject-matter defined by the claim is not patentable subject-matter or is prohibited under subsection 27(8) of the *Patent Act*.
>
> On the other hand, if running the algorithm on the computer improves the functioning of the computer, then the computer and the algorithm would together form a single actual invention that solves a problem related to the manual or productive arts and the

subject-matter defined by the claim would be patentable subject-matter and not be prohibited under subsection 27(8) of the *Patent Act*.

ANALYSIS

Purposive construction

The skilled person and their CGK

[18]   According to *Choueifaty* (at para 12), the characterizations of the skilled person and their CGK in *CD 1478* (at paras 30–35) were not at issue in the appeal. We adopt that characterization of the skilled person here: the skilled person is a team comprising members skilled with quantitative finance and finance portfolio optimization, with administrative processes for managing portfolios of securities and financial instruments, and with the networked computing hardware and software used to carry out these processes.

[19]   We generally adopt the characterization of the relevant CGK as well, but wish to clarify two of the points: there is no evidence that the equations identified as the Anti-Benchmark diversification ratio (R) and as equation (3) in the present application (pages 8 and 9 respectively) are part of the CGK, but the skilled person, upon reading them, would recognize ratio R as a quasi-concave function and equation (3) as a convex problem.

[20]   This clarification is based on the wording of the Froidure affidavit, which largely informed the inclusion of these points among the identified CGK (*CD 1478* at paras 11, 34–35; *Choueifaty* at paras 9, 12).

[21]   We also add to the identified CGK the use of software and computerized tools to automatically select securities, and create orders or make trades, thereby investing in a portfolio. This is based on the above identification of the skilled person and supported by the lack of detail in the present application concerning automated or computerized trading or investment, suggesting that the implementation of such is within the grasp of the skilled person and does not need explanation. The addition is also supported by what the following references, which arose during our review, describe in their background sections as generally known or conventionally done in the field:

- US 2003/0065598   April 3, 2003   Bunda

- US 2004/0148242   July 29, 2004   Liu

- US 2005/0273409   December 8, 2005   Voudrie

[22]   Accordingly, the relevant CGK includes:

- selecting and managing portfolios of securities/financial instruments including:

  - securities/financial instruments to include index funds, index trackers, fundamental indexes and diversity indexes;

  - various biases in portfolio selection, such as the small-cap, cyclic factor and valuations effects; and

  - various measures associated with portfolio management, such as alpha, beta, Sharpe ratio and the Efficient Frontier;

- general purpose computer systems and the internetworking of computers through networking means;

- knowledge permitting recognition of the Anti-Benchmark diversification ratio as an example of a quasi-concave function;

- knowledge permitting recognition of the equation labelled (3) in the present application (page 9) as an example of a convex problem;

- the fact that a quasi-concave or a quasi-convex function is a type of function that can be challenging to optimize when data sets are large;

- the fact that a convex problem may be solved significantly faster and more efficiently in terms of processing time and processing power than solving a quasi-concave or a quasi-convex problem, particularly for any portfolio that includes a large number of securities;

- the use of optimization software, such as MATLAB and the associated Optimization Toolbox, as "standard portfolio optimization techniques;" and

- the use of software and computerized tools to automatically select securities and create orders or make trades, thereby investing in a portfolio.

The essential elements

[23] Independent claims 1, 9, 17, 25, 33, 41, 49, 54 and 59 of the second proposed claims are directed to the identification or creation of a portfolio of securities for investment. Claims 1, 25 and 49 define methods, claims 9, 33 and 54 define computer-readable media, and claims 17, 41 and 59 define systems. Claims 1, 25 and 49 are provided below as representatives.

> Claim 1.   A computer-implemented method for providing an anti-benchmark portfolio, the method comprising:
>
> > acquiring, using a computer system, data regarding a first group of securities in a first portfolio, wherein the computer system comprises a computer processor and memory coupled to said processor;
> >
> > identifying, using a computer system, a second group of securities to be included in a second portfolio based on said data and on risk characteristics of said second group of securities; and
> >
> > providing, using a computer system, the individual weightings for each of the securities in said second portfolio according to one or more portfolio optimization procedures that maximizes the anti-benchmark ratio for the second portfolio wherein the anti-benchmark ratio is represented by the quotient of:
> >
> > > a numerator comprising an inner product of a row vector of holdings in said second portfolio and a column vector of a risk characteristic of return associated with said holdings in said second portfolio; and
> > >
> > > a denominator comprising the square root of a scalar formed by an inner product of said row vector of said holdings in said second portfolio and a product of a covariance matrix and a column vector of said holdings of said second portfolio;
> >
> > and further comprising:
> >
> > > transforming, using a computer system, said second portfolio into an equivariant portfolio via the Choueifaty Synthetic Asset Transformation and back-transforming said equivariant portfolio via the Choueifaty Synthetic Asset Back-Transformation.

Claim 25.   A computer-implemented method of creating a portfolio of securities using risk historical price data, said method being used by an investor that is active in the buying and selling of securities in a securities market, the method comprising:

reading and extracting from a database of periodically updated market information, using a computer system, historical market price data of each security in a first group of securities in a first portfolio, wherein the computer system comprises a central processing unit and memory, characterized in that the memory has program instructions stored thereon that are executable by the central processing unit,

upon receipt of market price data of each security; automatically identify and select from within said first group of securities, using the computer system a second group of securities to be included in a second portfolio based on said market price data of said second group of securities; and

automatically calculating according to the program instructions of the computer system, the individual weightings for each of the securities in said second portfolio according to one or more portfolio optimization procedures that maximizes a ratio for the second portfolio wherein the ratio is represented by the quotient of:

a numerator comprising an inner product of a row vector of holdings in said second portfolio and a column vector of a risk characteristic of return associated with said holdings in said second portfolio; and

a denominator comprising the square root of a scalar formed by an inner product of said row vector of said holdings in said second portfolio and a product of a covariance matrix and a column vector of said holdings of said second portfolio, wherein said second portfolio is the investment portfolio and the securities of such portfolio are each purchased together as a group and held by an investor;

and further comprising:

transforming, using a computer system, said second portfolio into an equivariant portfolio via the Choueifaty Synthetic Asset Transformation and back-transforming said equivariant portfolio via the Choueifaty Synthetic Asset Back-Transformation.

Claim 49.   A method comprising:

providing a first portfolio comprising a first group of securities, wherein each security in the first portfolio has a weight comprising a percent composition of each security in the first portfolio;

determining or providing a value for a first individual risk characteristic for each security in the first portfolio;

determining or providing a value for a second individual risk characteristic for each security in the first portfolio;

determining or providing a correlation of each security to each other security;

selecting from within the first portfolio a second group of securities selected from said first group of securities, wherein each security in the second group has a weight comprising a percent composition of each security in the second group;

determining a weighted average of the first individual risk characteristic of each security in the second group by adjusting the value of each first risk characteristic of each security in the second group according to the weight of the security in the second group and summing the adjusted values;

determining a value for an overall risk characteristic of the second group as a whole, using both the second individual risk characteristic of each security in the second group and the correlation of each security in the second group to each other security in the second group;

maximizing, using a computer system, a diversification ratio represented by a quotient having a numerator which is the weighted average of the first individual risk characteristic of each security in the second group of securities and a denominator which is the value of the overall risk characteristic of the second group as a whole;

the maximizing the diversification ratio comprising varying, using the computer, the weights of the securities in the second group;

the maximizing the diversification ratio further comprising using a synthetic asset transformation comprising a risk-free asset to transform the problem of maximizing the diversification ratio into an equivalent convex problem; wherein the second group with the weights required to maximize the diversification ratio comprises a second portfolio; and

investing in the second portfolio, wherein the second portfolio is maximally diversified.

[24]   Representative independent claims 1, 25 and 49 respectively refer to an "anti-benchmark ratio," a "ratio for the second portfolio" and a "diversification ratio." These three expressions are considered to refer to the same thing, the Anti-Benchmark diversification

ratio R defined in the description (page 8), which, in the course of determining the optimized portfolio of securities, must be maximized to maximize the diversification of the portfolio.

[25] Representative independent claims 1 and 25 recite the transformation of the second portfolio into an equivariant portfolio and back again via the "Choueifaty Synthetic Asset Transformation" and "Choueifaty Synthetic Asset Back-Transformation;" claim 49 does not use this exact language, but does recite the use of "a synthetic asset transformation comprising a risk-free asset to transform the problem of maximizing the diversification ratio into an equivalent convex problem." These expressions are considered to refer to the same sets of operations, those referred to in the description (pages 8 to 9) as the "Choueifaty Synthetic Asset Transformation" and the "Choueifaty Synthetic Asset Back-Transformation."

[26] The first set of operations is performed on ratio R to transform it into the function referred to as equation (3). According to the description, the minimization of this function is an equivalent problem to the maximization of ratio R, meaning that the solution to one can lead directly to the solution to the other. Effectively, producing and minimizing equation (3) "indirectly maximizes" ratio R. Once equation (3) is minimized, the second set of operations is performed on the result to determine the actual optimized portfolio of securities.

[27] The dependent claims recite further characteristics of the portfolio and of the involved calculations.

[28] There is no claim language indicating any of the elements to be optional, preferred embodiments or one of a list of alternatives. Nor is there any indication in the record before us that would lead to a determination of any claimed elements being non-essential. We therefore presume all the claimed elements to be essential.

Patentable subject matter

[29] When directing the Commissioner to reconsider this application, The Federal Court offered the following observations regarding the second proposed claims (*Choueifaty* at para 42):

The Appellant submits that the Commissioner mischaracterised the purpose (or solution) of the claimed invention to be simply the creation of a new financial portfolio. However, he notes that another purpose of the invention was to improve computer processing. The Commissioner failed to address this adequately in her decision. Specifically, she found that the problem and solution of the claims centred on financial management (yielding a new financial product), but did not explain why she excluded computer processing as a solution. This aspect of the invention requires closer examination.

[30] These observations reference the Applicant's submission that one of the purposes of the invention is to provide "an improvement in computer technology" by improving computer processing (*CD 1478* at paras 61–64; *Choueifaty* at paras 17–18).

[31] The Applicant's submission is based on certain operations taking place during the carrying out of the invention of any of the second proposed claims. As stated above, each of the second proposed claims involves the maximization of ratio R, which is a quasi-concave function, and which can thus be challenging to maximize, particularly where large data sets are involved. The claimed inventions address this by performing operations that "transform" ratio R into equation (3), which is a convex function and which can thus be minimized with significantly less processing and more speed. Once equation (3) is minimized, the optimized portfolio of securities can be determined as intended.

[32] The Froidure affidavit (point 16) explained why the equivalent problem of minimizing equation (3) is produced, discussed the relative speeds of optimizing the two equivalent problems, and included a technical report to support its assertions:

> Attached hereto as Exhibit "C" is my technical report that compares two different ways of constructing a portfolio that maximize the diversification ratio. The first one consists in the direct maximization of the diversification ratio, which is a quasi-concave function. The second approach maximizes the diversification ratio indirectly by transforming the problem of maximizing the quasi-concave diversification ratio into a convex optimization problem by using a synthetic asset transformation comprising cash (a risk-free asset), allowing to solve instead a convex optimization problem. The second approach is shown to be faster by approximately two orders of magnitude (50 to 200 times) when dealing with universes of five hundred equities or more, using standard optimization software such as MATLAB and associated Optimization Toolbox. This significant computation speed gain allows for example to create Anti-Benchmark portfolios in equity universes of 2,000 assets in less than a second rather than more than a minute and for 7,000 assets in less than half a minute rather

than more than an hour. This improvement in computer functionality represents significant gains for real world financial applications.

[33] As noted above, the Froidure affidavit was previously accepted, at least in part, by the Board in the identification of the relevant CGK. Nothing in *CD 1478* (see eg paras 11, 34–35, 49, 62–64) suggests that the submissions of the Froidure affidavit concerning the equivalent optimization problems should not be accepted. When the Federal Court referenced the affidavit in *Choueifaty* (see eg paras 9, 12, 42), it did not comment on its accuracy. Nor have we seen anything in the record before us to contradict the characterizations of these submissions.

[34] Thus, when carrying out any of the claimed inventions of the second proposed claims, the computer operations performed include those designated in the description as the Choueifaty Synthetic Asset Transformation and Back-Transformation, permitting the optimization to be performed with significantly less processing and greater speed than if ratio R were maximized directly. Accordingly, this can be considered an algorithm that improves the functioning of the computer used to run it, such as described in *PN2020–04*: the computer and the algorithm together form a single actual invention that has physicality and solves a problem related to the manual or productive arts.

[35] The subject matter of this case is reminiscent of that in *Schlumberger Canada Ltd v Commissioner of Patents*, [1982] 1 FC 845 (CA) at 204–06 [*Schlumberger*], where the Federal Court of Appeal explained that a mental process of making certain calculations according to certain mathematical formulae is not patentable subject matter, and that merely prescribing the calculations be made by computer cannot transform it into patentable subject matter. The claimed inventions of the second proposed claims can be considered to distinguish from those of *Schlumberger*, however, in that the computerized calculations here are not merely for yielding information, but for permitting the computer to carry out the portfolio optimization procedures with significantly less processing and greater speed. There was no suggestion in *Schlumberger* that the invention lay in the computer calculating its results with less processing or greater speed.

[36] Therefore, our view is that second proposed claims 1 to 63 define patentable subject matter and comply with section 2 of the *Patent Act*.

RECOMMENDATION OF THE BOARD

[37]   In view of the above, we recommend that the Applicant be notified, in accordance with subsection 86(11) of the *Patent Rules*, that the following amendments are necessary for compliance with the *Patent Act* and *Patent Rules*:

- delete claims 1 to 27 on file; and

- insert the second proposed claims 1 to 63, submitted October 1, 2018.

Leigh Matheson   Stephen MacNeil   Cara Weir

Member   Member   Member

DECISION OF THE COMMISSIONER

[38]   I concur with the conclusions of the Board and its recommendation.

[39]   Accordingly, under subsection 86(11) of the *Patent Rules*, I notify the Applicant that the following amendments must be made within three months of the date of this decision, failing which I intend to refuse to grant a patent for this application; in accordance with subsection 200(b) of the *Patent Rules*, these are the only amendments that may be made:

- delete claims 1 to 27 on file; and

- insert the second proposed claims 1 to 63, submitted October 1, 2018.

Virginie Ethier

Assistant Commissioner of Patents
Dated at Gatineau, Quebec
this 11th day of January, 2021