(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
27 November 2014 (27.11.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/187997 A1

(51) International Patent Classification:
G06Q 10/08 (2012.01)

(21) International Application Number:
PCT/EP2014/060752

(22) International Filing Date:
26 May 2014 (26.05.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
13169281.6 24 May 2013 (24.05.2013) EP

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

— *with international search report (Art. 21(3))*

(54) Title: SELF-LEARNING METHOD AND SYSTEM FOR AUTOMATICALLY CHECKING SHIPMENTS FOR CORRECTNESS

(57) Abstract: A self-learning method for automatically checking shipments for correctness comprises the steps of a) based on an dispatch order assembling an shipment comprising items of different types in individual quantities; b) weighing the shipment in order to obtain the actual total mass of the shipment; c) comparing the actual total mass with an expected total mass; and d) generating an error message when the actual total and the expected total mass differ by more than a predetermined tolerance value. The expected total mass is determined for each dispatch order by e) checking a database if information on the individual specific mass of each item of the dispatch order is present to calculate the sum of the individual specific masses times the individual quantities of the items that should according to the dispatch order be contained in the shipment and, if information on the individual specific masses of all items of the dispatch order is present, calculating the expected total mass; if information on the individual specific masses of only some items or no item of the dispatch order is present, storing in said database at least information on the individual quantities of each item of the dispatch order, of which the individual specific mass is unknown, and information at least on the actual total mass of those items to obtain an equation and f) repeating steps a) - e) for further dispatch orders, wherein each time an item with an unknown specific mass is present in an dispatch order, the information in said database is automatically checked, if the information is sufficient for calculating the specific mass of said item and possibly of other items, and if the information is sufficient, automatically calculating the specific mass and storing this information in said database.

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SELF-LEARNING METHOD AND SYSTEM FOR AUTOMATICALLY CHECKING SHIPMENTS FOR CORRECTNESS

TECHNICAL FIELD

The invention relates to a self-learning method and a system for automatically checking shipments for correctness, said shipments comprising several items in several quantities, which are individually assembled based on a dispatch order for the respective shipment.

TECHNICAL BACKGROUND

Mail ordering has become a widely used way of buying goods. More and more companies offer virtual department stores, in which the customers can electronically put goods in a shopping cart that later will be transferred by the respective company into an dispatch order, so that in a warehouse a shipment comprising the items ordered (and sometimes additional items such as samples, vouchers, invoices, etc.) can be assembled based on the respective dispatch order.

Checking the correctness of a shipment has always been a challenge in the mail order business, even in cases where the warehouse is operated more or less fully automated, in particular when a shipment comprises several items of different types and in different quantities. A person assembling the items of the order by taking out the respective items from a storage rack may take out the wrong quantity or the wrong item. In case of automatic transport of the ordered items to a packaging station, some of the items may fall of the transport line. Numerous other causes for incorrectness of a shipment are known.

Since freight and postal charges often depend on the mass of a shipment to be transported, assembled shipments are - before or after packaging - generally weighed. If the individual masses of the items forming the shipment are known, the total mass of the shipment is generally an indicator for the correctness of the shipment, since it is

then possible to calculate an expected mass of the shipment based on the masses of the individual items of the shipment and to compare this expected mass with the measured actual mass of the shipment. If the actual mass is lower than the expected mass, one or more items, which according to the dispatch order should form part of the shipment, may be missing. If the actual mass is greater than the expected mass, erroneously more items than ordered or different items than ordered may be contained in the shipment. The shipment can then be sorted out for further inspection. It should be noted that "correctness" in the sense of this application means that the dispatch order is exactly fulfilled, i.e. that not only not less than the ordered items are present, but also that not more than the items according to the dispatch order are present, that no parts of an item are missing and that the correct items are shipped.

DISCLOSURE OF THE INVENTION

In particular when a company operates a warehouse with numerous different items provided by several suppliers, it has turned out to be very complex and time consuming to maintain a database, in which for each item the individual mass is stored. Items to be shipped may be items having their own package, for example a pair of earphones in a blister pack. Often suppliers make changes only affecting the individual package of the respective item, for example change a filling material that might be present in the respective package, which does not affect in any way the quality of the item itself, but affects the mass of the individual package, in which the item is contained. Since the quality of the item is not changed, the supplier may not notify the company operating the warehouse about the change. Since, for the purpose of shipment, not the item itself, but the item with its individual package forms one "item to be sent", an error message may be generated erroneously. Also, when a company introduces a new system for automatic packaging shipments, in standard or custom-sized packages, the company may for the first time be able to effectively use the total mass of the shipment for a quality check concerning the correctness of the shipment and may therefore not be in possession of a database with the individual masses of all items (including their respective individual packaging) that the company may want to ship.

It is an object of the invention to provide a self-learning method and system, which upon operation over the time automatically obtain the necessary information on the individual masses of the shipped items to perform an increasingly precise correctness check.

The object is achieved by a method as set out in claim 1 respectively by a system as set out in claim 10. The respective dependent claims are directed to advantageous ways of performing the method respectively advantageous embodiments of the system.

One major advantage of the invention is, that even if initially no information on the masses of the items to be shipped is known, during operation with each new shipment more information is gathered that over the time allows to automatically calculate the individual masses of the items and thus to fill or update a corresponding database.

Further objectives, advantages and details of the invention will become apparent from the following description of preferred embodiments, which is given by means of non-limiting examples.

DESCRIPTION OF PREFERRED EMBODIMENTS

A self-learning system for automatically checking shipments for correctness according to the invention will now be described. From this description, also the method according to the invention becomes apparent.

The system comprises means for weighing an i-th shipment S_i, wherein i is an integer used in this application to distinguish several shipments from each other. Each of those shipments comprises one or more items A_j of n different types in n individual quantities $q(A_j)_i$, with j being an integer running from 1 to n and n being a positive integer. Hence, a first shipment S_1 may comprise 2 books B, 3 CDs C, a pair of earphones E and a custom sized package P made from 0,5 m^2 of corrugated cardboard. All these items are assembled together according to a first dispatch order O_1 and have a total mass MT_1 of for example 1,500 g. In that case, j would run from 1 to 4 and A_1 would be the books, $q(A_1)_1$ would be 2, A_2 would be the CDs, $q(A_2)_1$ would be 3, A_3 would be the

earphones, $q(A_3)_1$ would be 1 and A_4 would be the custom sized package, $q(A_4)_1$ would be 0.5 m^2.

It should be noted that under the term "dispatch order" machine readable information on the items that should form the shipment is understood, which will normally contain the actual list of items ordered by a customer and additional information for example on the sizes of the package to be used or, in case a custom sized package is prepared, information on the dimensions of such package, as well as information on additional items to be included in the shipment, such as for example an invoice, vouchers, samples of other products and filling material.

According to the invention, the system further comprises means for determining an expected total mass ME_i for each dispatch order O_i by checking a data base if information on the individual specific mass $m(A_j)$ of each item A_j of the dispatch order O_i is present to calculate the sum of all individual specific masses $m(A_j)$ times the individual quantities $q(A_j)_i$ of the items that according to the dispatch order O_i should be contained in the respective shipment S_i.

If the necessary information on the individual specific masses $m(A_j)$ of all items of the dispatch order O_i is present in the data base, the expected total mass ME_i is calculated and compared with the actual total mass MT_i as measured. If the actual total mass MT_i and the expected total mass ME_i differ by more than a predetermined tolerance value D_i, an error message is generated. Such error message can be an optical and/or acoustical signal, so that an operator of the system may manually mark or sort out the respective shipment to be further examined. It should be noted that under the term "error message" not only direct signals to an operator are to be understood, but also all forms of control signals that lead to providing the shipment for example with a label, a printing or the like, marking the shipment as (possibly) incorrect so that it should be manually inspected, and/or that lead to manually or automatically sorting the shipment out for manual inspection, without interrupting the packaging process.

In a preferred embodiment, the error message may be forwarded to means for automatically sorting out the shipment and/or marking the shipment for further

examination. Such marking can be done in several ways. For example, a red label may be attached to the shipment or the lid of a package used may be left open.

If the data base does not contain information on all the individual specific masses $m(A_j)$ of the items A_j that shall form the shipment according to the respective dispatch order O_i, at least the actual total mass RTM_i of those items, of which the individual specific mass $m(A_j)$ is unknown and information on the individual quantities $q(A_j)_i$ of those items in the respective shipment is stored and an expected mass ME_i is estimated for performing at least a plausibility check, as will be explained later on. If for example the actual total mass TM_i of an i-th shipment is 1 kg and the shipment is comprised by two items A_1, of which the individual specific mass $m(A_1)$ is known to be for example 200 g, and one item A_2 and one item A_3, of which the individual specific masses $m(A_2)$ and $m(A_3)$ are unknown, it is not necessary to store the information that

$$1\ \text{kg} = 2 \times 200\ \text{g} + 1 \times m(A_2) + 1 \times m(A_3).$$

It is fully sufficient to store the information on the "remaining" total mass after deducting the known mass, i.e. it is sufficient to store

$$600\ \text{g} = 1 \times m(A_2) + 1 \times m(A_3).$$

In this way, over the time in the data base a set of r equations with s unknowns is accumulated, $r, s \in \mathbb{N}_+$. Each time r equals s, the system is in a position to solve the equations and hence to obtain those unknown individual specific masses that are part of the set of equations.

Example:

A first shipment S_1 assembled according to a first dispatch order O_1 may contain 2 items A_1, 3 items A_2 and 0,5 m^2 of item A_3 (the cardboard, of which a custom sized package is made). The measured actual total mass TM_1 of this first shipment may be 1,600 g.

A second shipment S_2 assembled according to a second dispatch order O_2 may contain 2 items A_2, 1 item A_4 and 0.6 m^2 of A_3. The measured actual total mass TM_2 of this shipment may be 1,560 g.

A third shipment S_3 may have a total mass TM_3 of 680 g and may according to a third dispatch order O_3 contain 1 item A_1, 1 item A_2 and 0.3 m^2 A_3.

The information on TM_i and on the quantities $q(A_j)_i$ of the items in each shipment is stored in the data base. The system notices that so far it has 3 equations with 4 unknowns.

Now a fourth shipment S_4 may comprise according to a fourth dispatch order O_4 4 items A_2 and 0.4 m^2 A_3, having a measured actual total mass TM_4 of 1,440 g. At this point in time, the system notices that there are now 4 equations with 4 unknowns, which can easily be solved, for example by starting with the equation

$$1{,}440\ \text{g} = 4\ m(A_2) + 0.4\ [\text{m}^2]\ A_3$$

and rearranging this equation to an expression for A_2:

$$4\ A_2 = 1{,}440\ \text{g} - 0{,}4\ [\text{m}^2]\ A_3 \text{ or}$$

$$A_2 = 360\ \text{g} - 0.1\ [\text{m}^2]\ A_3$$

This can then for example be entered into the equation

$$630\ \text{g} = A_1 + A_2 + 0.3\ [\text{m}^2]\ A_3$$

so that this equation becomes

$$320\ \text{g} = A_1 + 0.2\ [\text{m}^2]\ A_3$$

which can be formed into an expression for A_1:

A_1 = 320 g - 0,2 [m^2] A_3

This can then be entered for example in the for TM_1 expression to read

1,600 g = 2 (320 g - 0.2 [m^2] A_3) + 3 (360 g - 0.1 [m^2] A_3) + 0.5 [m^2] A_3

which leads to

-120 g = -0,2 [m^2] A_3

or

A_3 = 600 g/m^2.

Having thus calculated the individual specific mass $m(A_3)$ to be 600 g/m^2, it then immediately follows that the individual specific masses of the other items are

$m(A_1)$ = 200 g, $m(A_2)$ = 300 g and $m(A_4)$ = 600 g (each per piece).

It should be noted that, as in the example case, the individual quantities $q(A_j)_i$ of an item A_j can be measured in any suitable way and can for example be simply the number of respective items or, for example with respect to the cardboard from which a custom sized package is formed, a surface or, for example the case of filling material, a volume.

Accordingly, the specific individual mass $m(A_j)$ can be given in any suitable way, for example weight per piece, weight per surface or weight per volume.

Although in the example case no information on the individual specific masses of the respective items was initially known, the system learned just "on the fly" (during operation) and acquired the necessary information, which then could be used for calculating an expected total mass ME_i for each shipment S_i based on the information in the dispatch order O_i.

It should also be noted that, depending on the environment, in which the system and the corresponding method are used, the "dispatch order" may not be an actual existing

order but may be automatically generated by corresponding means, for example scanners, barcode readers or other suitable equipment that looks at some point in time at the shipment that is being processed, for example packed, and then later compares the actual total mass of the shipment with the expected total mass.

Also depending on the environment, in which the method and the system according to the invention are used, a package for the shipment may be considered as forming part of the shipment and may be treated accordingly as an item of the shipment or may be treated completely separately. Accordingly, it is possible to obtain the actual total mass of the shipment before or after packing the items into a suitable package.

As is apparent from the above, during the initial process it is assumed that the shipments are complete, i.e. that the weighed actual total mass of a shipment indeed results from the individual specific masses and individual quantities of the items of the shipment according to the dispatch order. If this is not true, for example because in a certain shipment only 3 items A_i were included instead of 4 items, which should be included according to the corresponding dispatch order, the calculated specific mass $m(A_i)$ would obviously not be correct. However, in a preferred embodiment of the invention such errors, as well as changes in the respective individual specific mass of a certain item, which may for example be due to changes a supplier of the respective item has made for example to the individual package of the item, are automatically corrected. For this purpose, the differences between the expected total masses ME_i and the actual total masses MT_i of the shipments are regularly monitored. It is apparent that in case the individual specific masses are, for which ever reason, not correct, the deviation between the measured actual total mass and the expected total mass will generally be of a certain type, i.e. the actual total mass will always be larger or always be smaller than expected. If such tendency to deviate in a certain direction is noticed, the individual specific mass $m(A_i)$ of an item A_j, which regularly leads to deviations between the expected total mass and the actual total mass of the shipment, can be recalculated automatically and the corresponding information the data base can be updated.

It should be also noted that the tolerance value D_i, by which the actual total mass MT_i and the expected total mass ME_i of an i-th shipment may differ from each other without

resulting in the generation of an error message, is in an preferred embodiment individually set for the respective shipment, based for example on information concerning the items of the shipment. For example, it may be known that the individual masses of certain items have a strong tendency to differ from each other, so that the respective item sometimes weigh 200 g, sometimes 210 g. In such cases, a respective indicator, for example a flag, may be generated, so that the tolerance value D_i is set higher than in cases where the items of the same type always have almost the same mass. It is also possible possible to assign individual tolerance values to each individual specific mass $m(A_j)$, so that a specific tolerance value D_j can be calculated for a specific shipment.

When the information in the database is not sufficient to calculate an expected total mass value ME_i, such value may be estimated based on certain values in order to perform at least a plausibility check for the respective shipment. For example, even in case custom sized packages are made, the respective machine may have a minimum package size, which would lead to a minimum weight even if the shipment contains only of an empty package. Hence, it is possible to set at least a minimum value higher than the weight of the smallest possible package that a shipment should have if it does not only contain an empty package.

CLAIMS

1. Self-learning method for automatically checking shipments for correctness, comprising the steps of

a) based on an i-th dispatch order O_i, assembling an i-th shipment S_i comprising items A_j of n different types in n individual quantities $q(A_j)_i$, ($j = 1, ..., n$; $i, n \in \mathbb{N}_+$),

b) weighing the shipment in order to obtain the actual total mass MT_i of the shipment,

c) comparing the actual total mass MT_i with an expected total mass ME_i and

d) generating an error message when the actual total MT_i and the expected total mass ME_i differ by more than a predetermined tolerance value D_i,

wherein said expected total mass ME_i is determined for each dispatch order O_i by

e) checking a database if information on the individual specific mass $m(A_j)$ of each item A_j of the dispatch order is present to calculate the sum of the individual specific masses $m(A_j)$ times the individual quantities $q(A_j)_i$ of the items that should according to the dispatch order O_i be contained in the shipment S_i, and

- if information on the individual specific masses $m(A_j)$ of all items A_j of the dispatch order O_i is present, calculating the expected total mass ME_i,

- if information on the individual specific masses $m(A_j)$ of only some items or no item A_j of the dispatch order O_i is present, storing in said database at least information on the individual quantities $q(A_j)_i$ of each item A_j of the dispatch order O_i, of which the individual specific mass $m(A_j)$ is unknown, and information at least on the actual total mass RTM_i of those items to obtain an equation of the type RTM_i = (sum of all $q(A_j)_i$ times $m(A_j)$, of the which the individual specific mass $m(A_j)$ is unknown),

f) repeating steps a) - e) for further dispatch orders, wherein each time an item A_j with an unknown specific mass $m(A_j)$ is present in an dispatch order, the information in said database is automatically checked, if the information is sufficient for calculating the specific mass $m(A_j)$ of said item and possibly of other items, and if the information is sufficient, automatically calculating the specific mass $m(A_j)$ and storing this information in said database.

2. Method according to claim 1, wherein each individual quantity of $q(A_j)_i$ of an item A_j is one of a number of pieces, a volume and a surface and the specific individual mass $m(A_j)$ is one of a mass per piece, mass per surface and mass per volume.

3. Method according to claim 1 or 2, wherein a package, in particular a custom sized package made individually for the specific shipment, forms part of the shipment and is treated like any other item A_j of the shipment.

4. Method according to one of claims 1 to 3, wherein filling material forms part of the shipment and is treated like any other item A_j of the shipment.

5. Method according to one of claims 1 to 4, wherein the error message is forwarded to a unit for automatic sorting out the respective shipment for further examination.

6. Method according to one of claims 1 to 5, wherein the error message is forwarded to a unit for automatic marking the respective shipment for further examination.

7. Method according to one of claims 1 to 6, wherein the tolerance value D_i, is individually predetermined for a shipment S_i based on information on the quantities $q(A_j)_i$ and the type of the items A_j that according to the respective dispatch order O_i. should form the shipment S_i.

8. Method according to one of claims 1 to 7, wherein the differences between the the expected total mass ME_i, and the actual total mass MT_i of the shipments are monitored, and, if the differences for shipments containing certain items show a tendency to deviate in a certain direction, the individual specific masses $m(A_j)$ of those items are recalculated and the corresponding information in the database is updated.

9. Method according to one of claims 1 to 8, wherein the expected mass ME_i is estimated in case the information in the database is not sufficient to calculate the expected total mass ME_i.

10. Self-learning system for automatically checking shipments for correctness, comprising:

- means for weighing an i-th shipment S_i comprising items A_j of n different types in n individual quantities $q(A_j)_i$, ($j = 1, ..., n; i, n \in \mathbb{N}_+$) based on an i-th dispatch order O_i and obtaining the actual total mass MT_i of the shipment,
- means
  -- for determining an expected total mass ME_i for the dispatch order O_i by checking a database if information on the individual specific mass $m(A_j)$ of each item A_j of the dispatch order O_i is present to calculate the sum of the individual specific masses $m(A_j)$ times the individual quantities $q(A_j)_i$ of the items that should according to the dispatch order O_i be contained in the shipment S_i, and
  -- for calculating the expected total mass ME_i, if information on the individual specific masses $m(A_j)$ of all items A_j of the dispatch order O_i is present, and
  -- for storing in said database, if information on the individual specific masses $m(A_j)$ of only some items or no item A_j of the dispatch order O_i is present, at least information on the individual quantities $q(A_j)_i$ of each item A_j of the dispatch order O_i, of which the individual specific mass $m(A_j)$ is unknown, and at least on the actual total mass RTM_i of those items to obtain an equation of the type RTM_i = (sum of all $q(A_j)_i$ times $m(A_j)$, of the which the individual specific mass $m(A_j)$ unknown),
  -- for checking each time an item A_j with an unknown specific mass $m(A_j)$ is present in an dispatch order the information in said database, if the information is sufficient for calculating the specific mass $m(A_j)$ of said item and possibly of other items, and if the information is sufficient, automatically calculating the specific mass $m(A_j)$ and storing this information in said database,
- means for comparing the actual total mass MT_i with the expected total mass ME_i of the shipment,
- means for generating an error message when the actual total MT_i and the expected total mass ME_i differ by more than a predetermined tolerance value D_i.

11. System according to claim 10, further comprising means for automatically making a custom sized package.

12. System according to claim 10 or 11, further comprising means for sorting out a shipment for further examination, when an error message concerning this shipment is generated.

13. System according to one of claims 10 to 12, further comprising means for marking a shipment for further examination, when an error message concerning this shipment is generated.

14. System according to one of claims 10 to 13, further comprising means for individually determining said tolerance value D_i, for a shipment S_i based on information in the respective dispatch order O_i.

15. System according to one of claims 10 to 14, further comprising means for monitoring the differences between the expected total mass ME_i, and the actual total mass MT_i of the shipments, and for recalculating, if the differences for shipments containing certain items show a tendency to deviate in a certain direction, the individual specific masses $m(A_j)$ of those items and updating the corresponding information in the database.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/060752

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06Q10/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
L	EPO: "Mitteilung des Europäischen Patentamts vom 1. Oktober 2007 über Geschäftsmethoden = Notice from the European Patent Office dated 1 October 2007 concerning business methods = Communiqué de l'Office européen des brevets,en date du 1er octobre 2007, concernant les méthodes dans le domaine des activités", JOURNAL OFFICIEL DE L'OFFICE EUROPEEN DES BREVETS.OFFICIAL JOURNAL OF THE EUROPEAN PATENT OFFICE.AMTSBLATTT DES EUROPAEISCHEN PATENTAMTS, OEB, MUNCHEN, DE, vol. 30, no. 11, 1 November 2007 (2007-11-01), pages 592-593, XP007905525, ISSN: 0170-9291 Statement in accordance with the Notice from the European Patent Office dated 1 October 2007 concerning business	1-15

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
30 June 2014	04/07/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Moltenbrey, Michael

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	methods(OJ 11/2007; p592-593) The claimed subject matter, with due regard to the description and drawings, relates to processes comprised in the list of subject matter and activities for which no search is required under Rule 39 PCT. The only identifiable technical aspects of the claimed invention relate to the use of conventional, general-purpose data processing technology for processing data of an inherently non-technical nature. The information technology employed is considered to have been generally known as it was widely available to everyone at the date of filing/priority of the present application. The notoriety of such prior art cannot reasonably be contested. No documentary evidence was therefore considered required. -----	