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(54) **APPARATUS AND METHOD FOR CREATING
NEW REPORTS FROM A CONSOLIDATED
DATA MART**

Related U.S. Application Data

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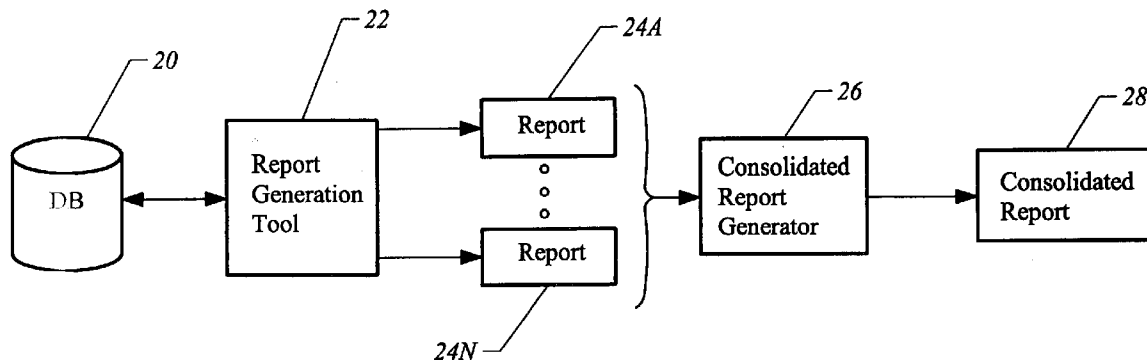
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(57) **ABSTRACT**

The invention includes a computer readable memory with a consolidated data mart generator to generate a consolidated data mart based upon an analysis of a repository of individual reports. A report generation tool produces a report via access to the consolidated data mart.

(21) Appl. No.: **11/182,486**

(22) Filed: **Jul. 14, 2005**



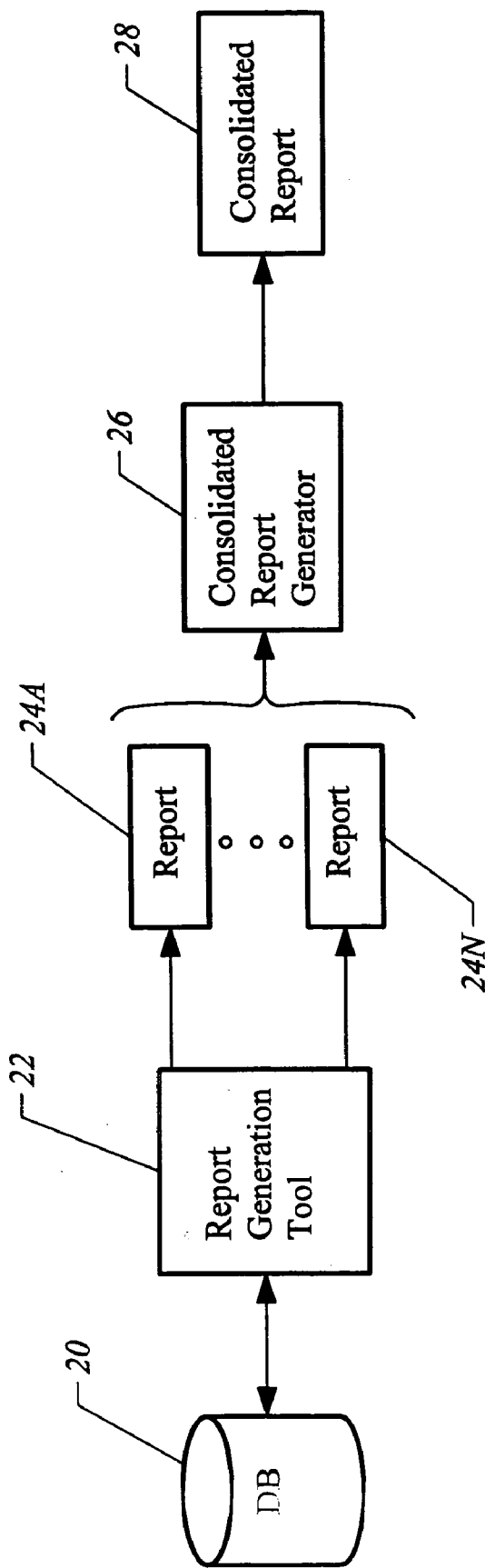


FIG. 1

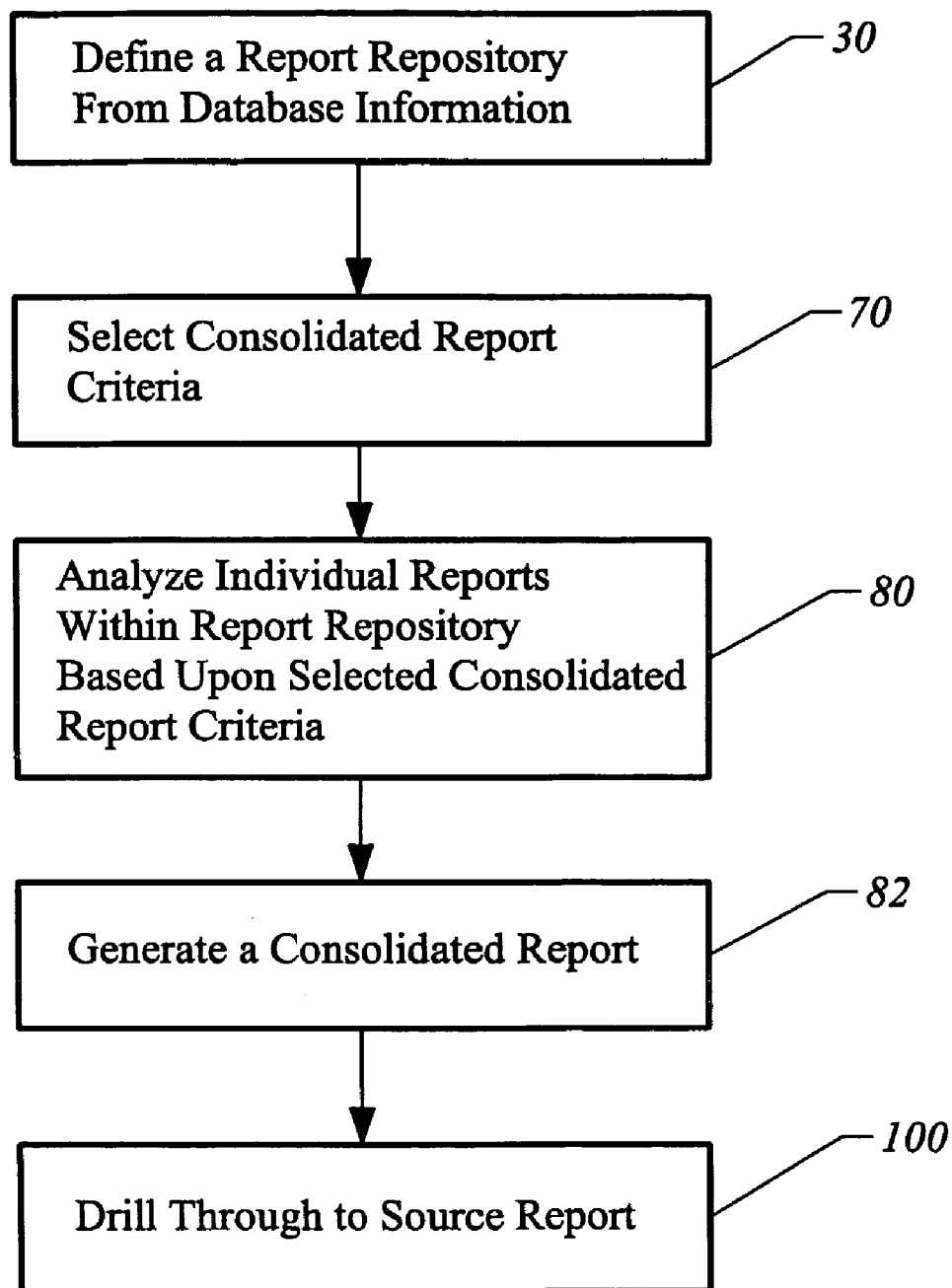


FIG. 2

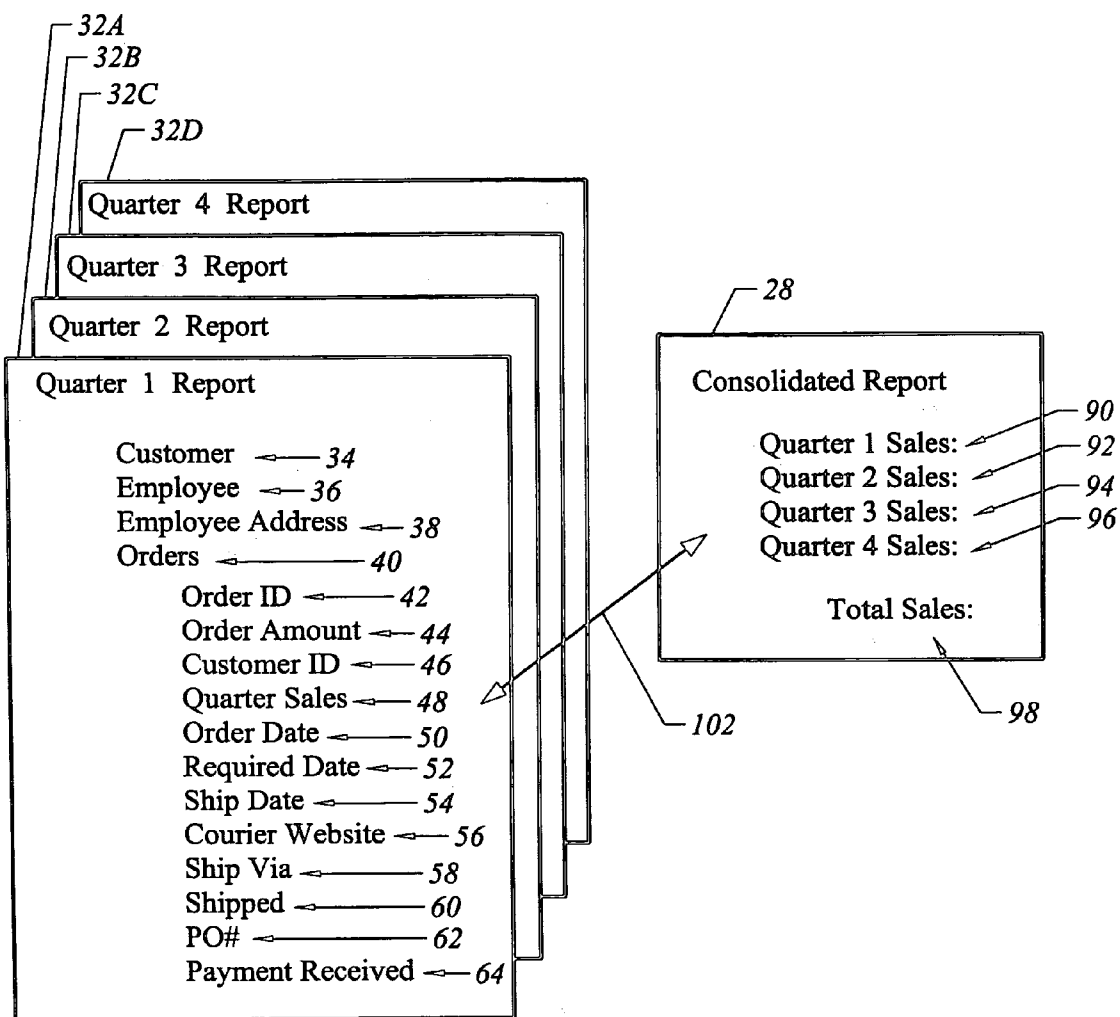


FIG. 3

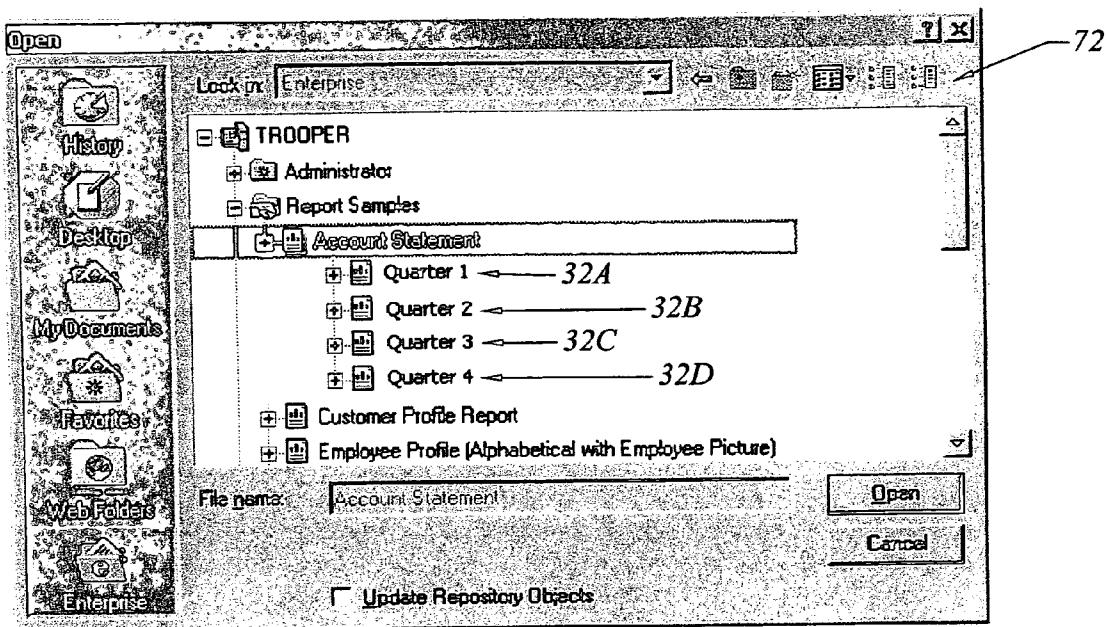


FIG. 4

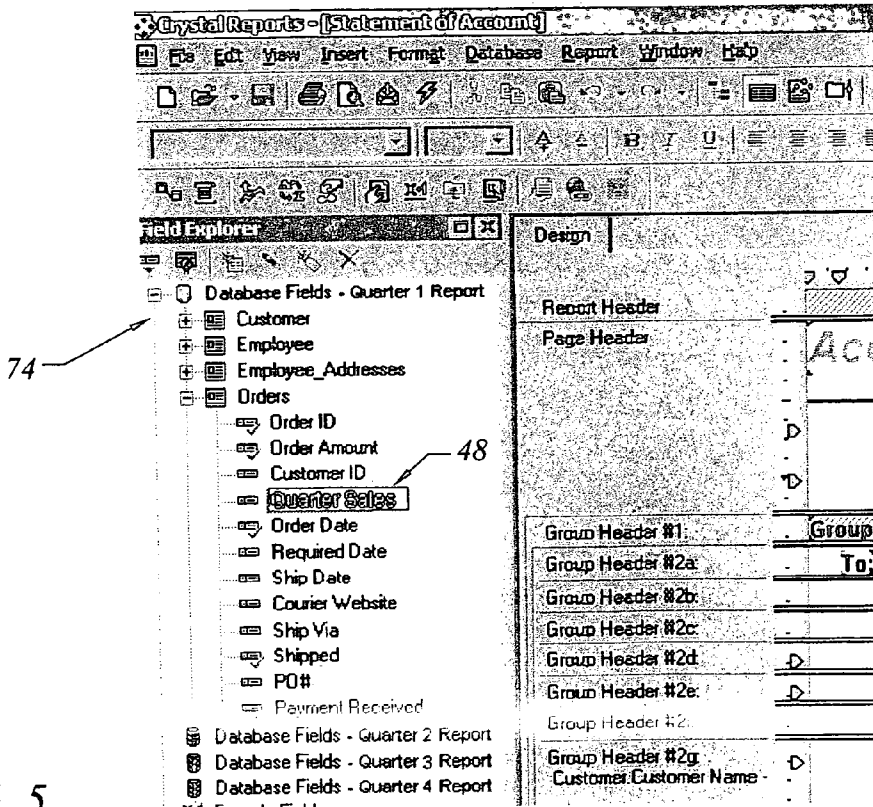


FIG. 5

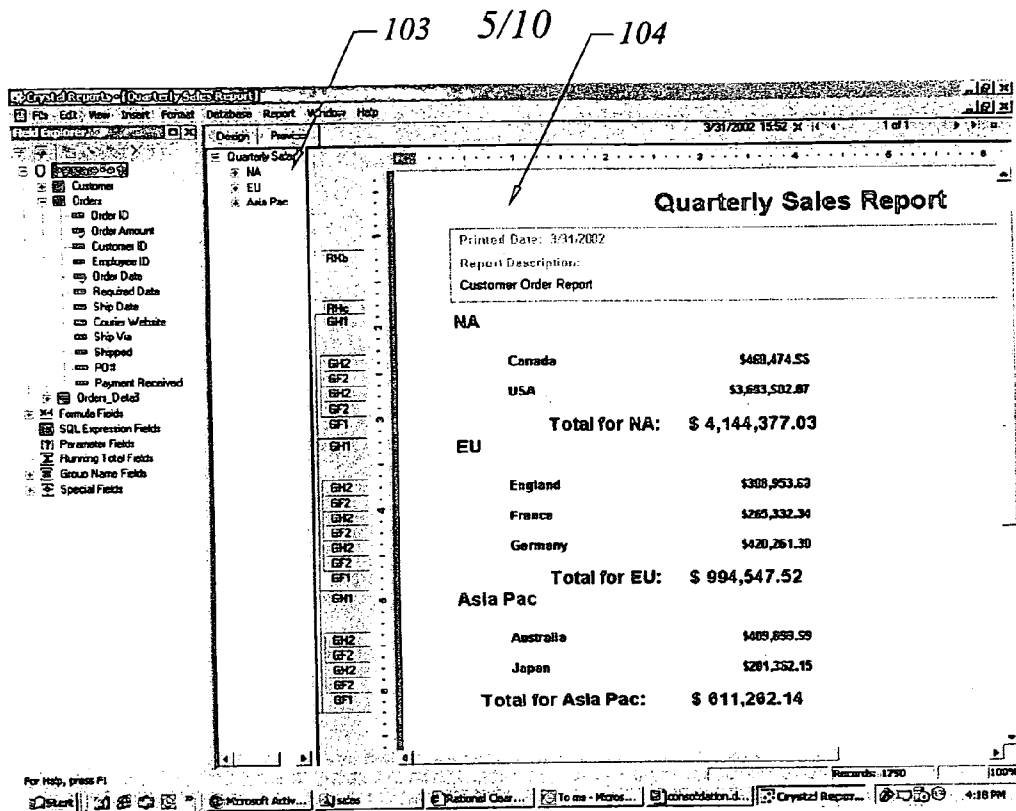


FIG. 6

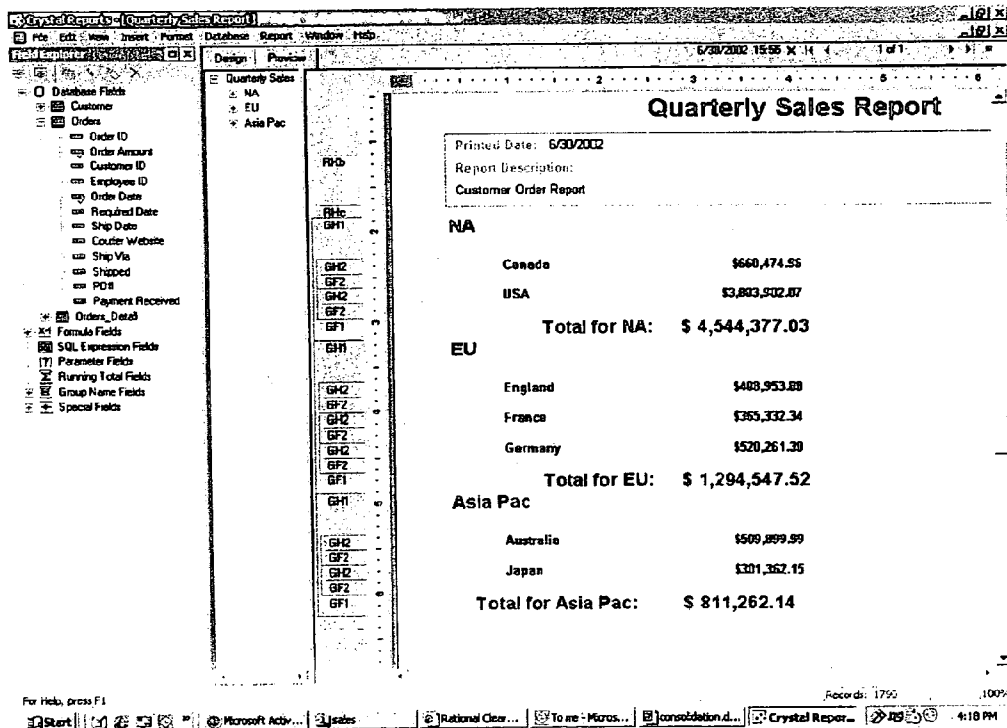


FIG. 7

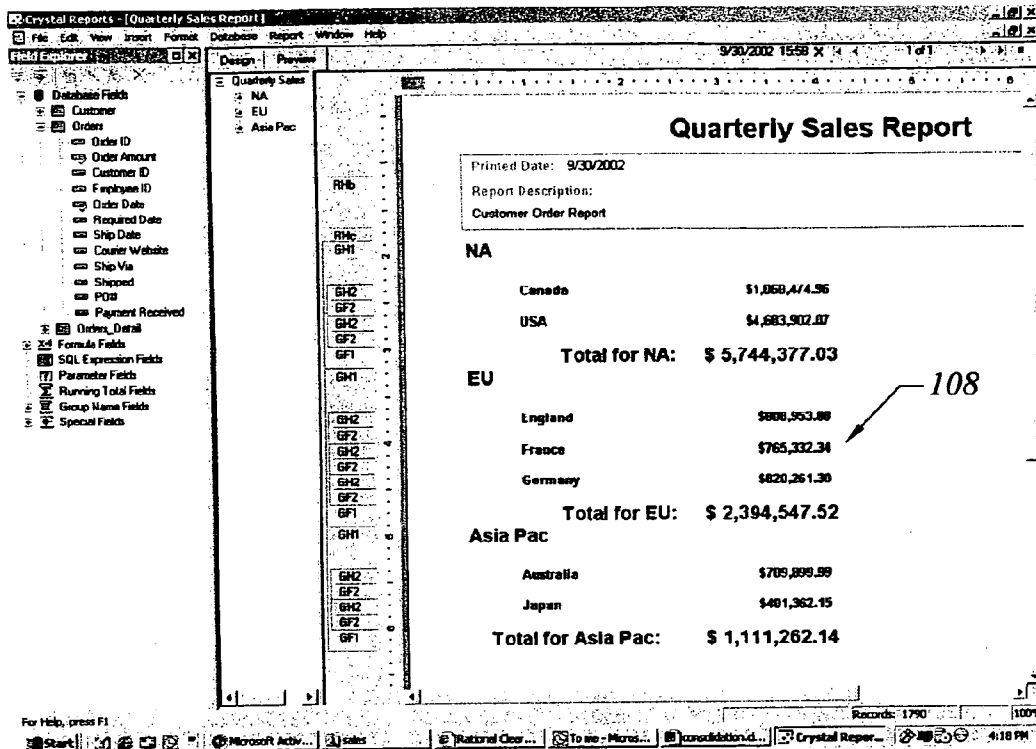


FIG. 8

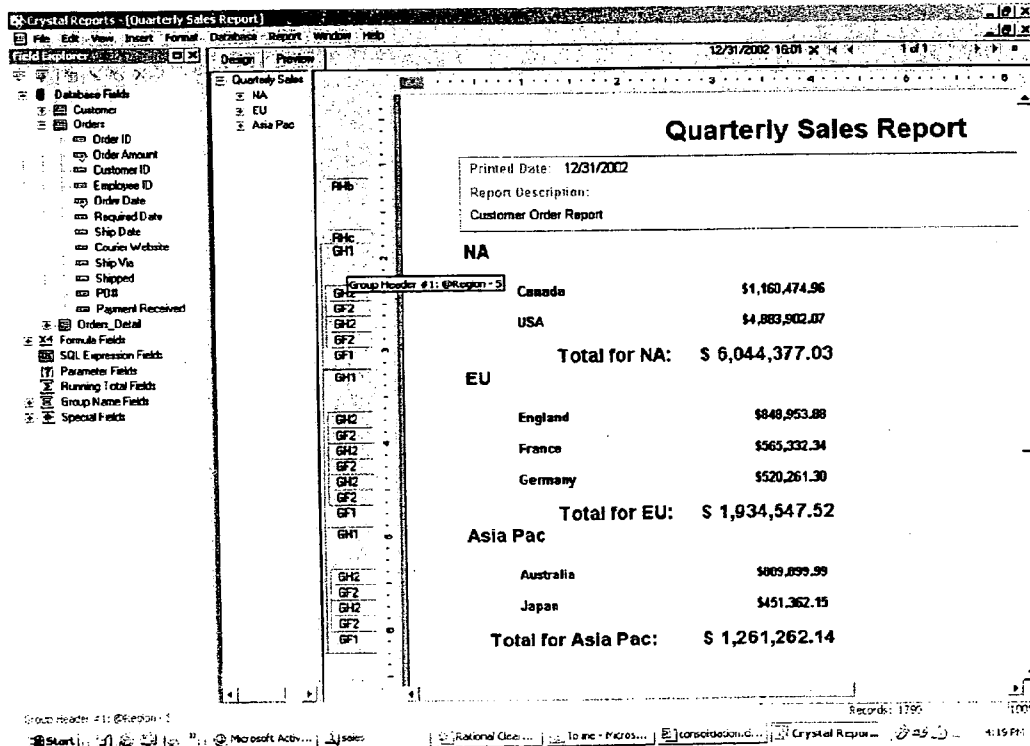


FIG. 9

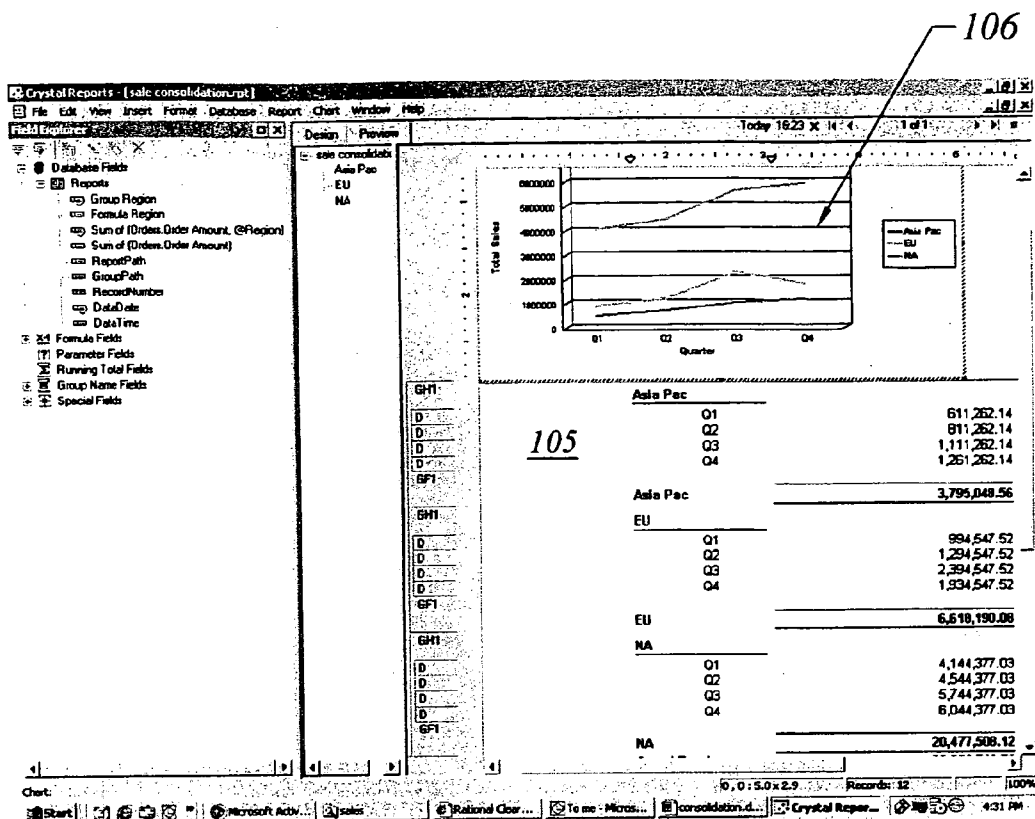


FIG. 10

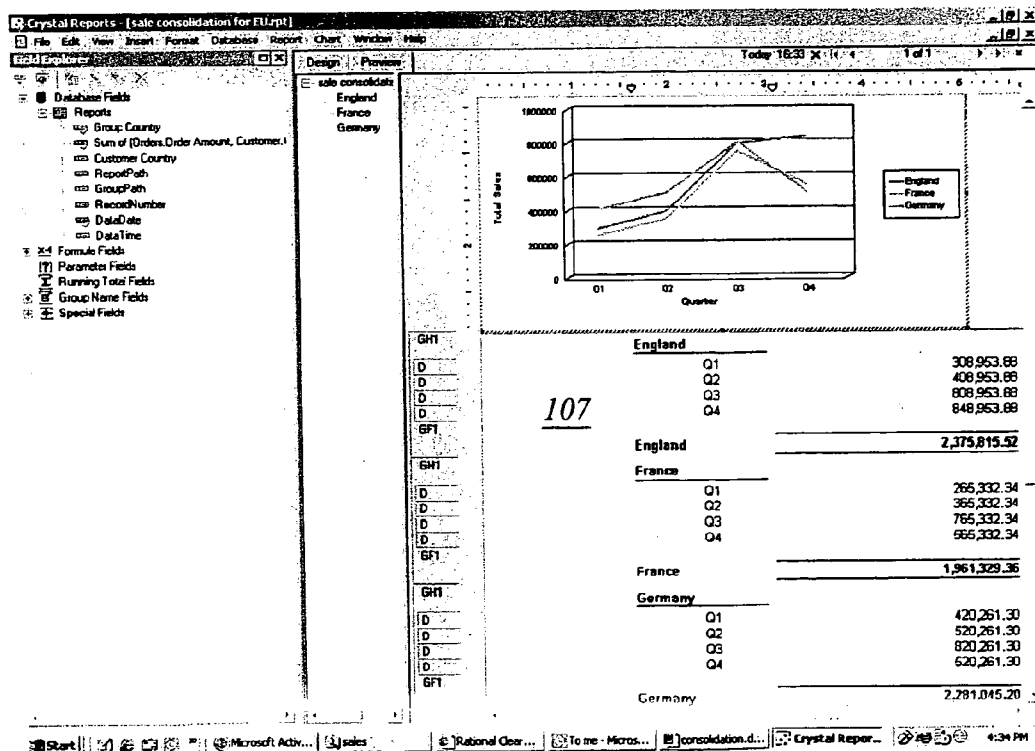


FIG. 11

109

France		France	\$765,332.34	
France	Paris Mountain Sports33-4-92-72-04-89	Bertrand@toulousevelos.com		
http://www.crystaldecisions.com	\$106.30	12/12/2000 12:00:00AM		
France	Paris Mountain Sports33-4-92-72-04-89	Bertrand@toulousevelos.com		
http://www.crystaldecisions.com	\$43.80	1/5/2001 12:00:00AM		
France	Paris Mountain Sports33-4-92-72-04-89	Bertrand@toulousevelos.com		
http://www.crystaldecisions.com	\$21.60	1/6/2001 12:00:00AM		
France	Paris Mountain Sports33-4-92-72-04-89	Bertrand@toulousevelos.com		
http://www.crystaldecisions.com	\$161.70	1/15/2001 12:00:00AM		
France	Paris Mountain Sports33-4-92-72-04-89	Bertrand@toulousevelos.com		
http://www.crystaldecisions.com	\$24.00	1/30/2001 12:00:00AM		
France	Paris Mountain Sports33-4-92-72-04-89	Bertrand@toulousevelos.com		
http://www.crystaldecisions.com	\$36.00	1/31/2001 12:00:00AM		
France	Paris Mountain Sports33-4-92-72-04-89	Bertrand@toulousevelos.com		
http://www.crystaldecisions.com	\$2,328.45	5/1/2001 12:00:00AM		
France	Paris Mountain Sports33-4-92-72-04-89	Bertrand@toulousevelos.com		
http://www.crystaldecisions.com	\$413.85	5/24/2001 12:00:00AM		
France	Paris Mountain Sports33-4-92-72-04-89	Bertrand@toulousevelos.com		
http://www.crystaldecisions.com	\$3,024.85	6/19/2001 12:00:00AM		
France	Paris Mountain Sports33-4-92-72-04-89	Bertrand@toulousevelos.com		
http://www.crystaldecisions.com	\$1,078.70	7/20/2001 12:00:00AM		
France	Paris Mountain Sports33-4-92-72-04-89	Bertrand@toulousevelos.com		
http://www.crystaldecisions.com	\$1,530.42	7/29/2001 12:00:00AM		
France	Paris Mountain Sports33-4-92-72-04-89	Bertrand@toulousevelos.com		
http://www.crystaldecisions.com	\$23.50	8/17/2001 12:00:00AM		
France	Paris Mountain Sports33-4-92-72-04-89	Bertrand@toulousevelos.com		

FIG. 12

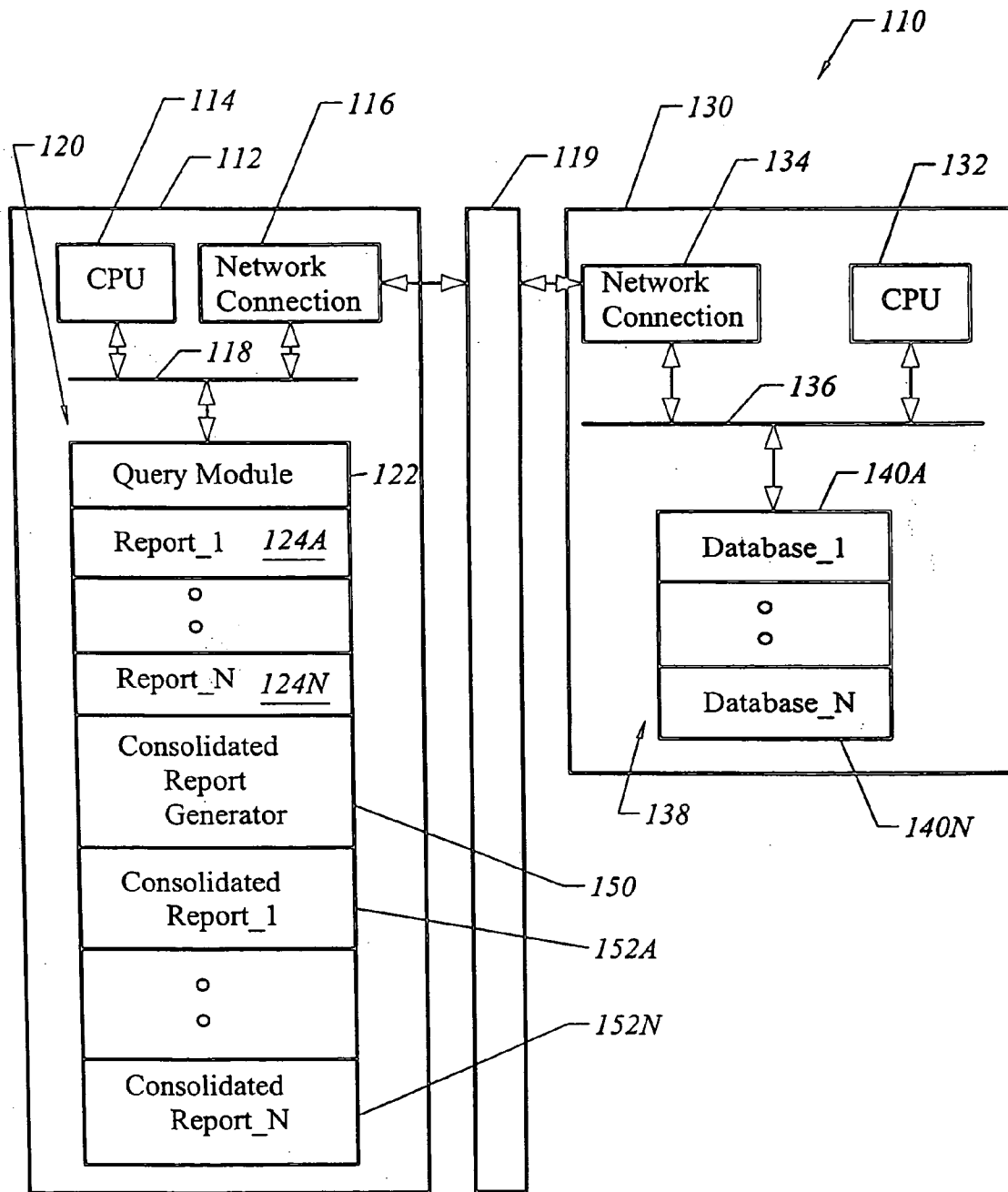
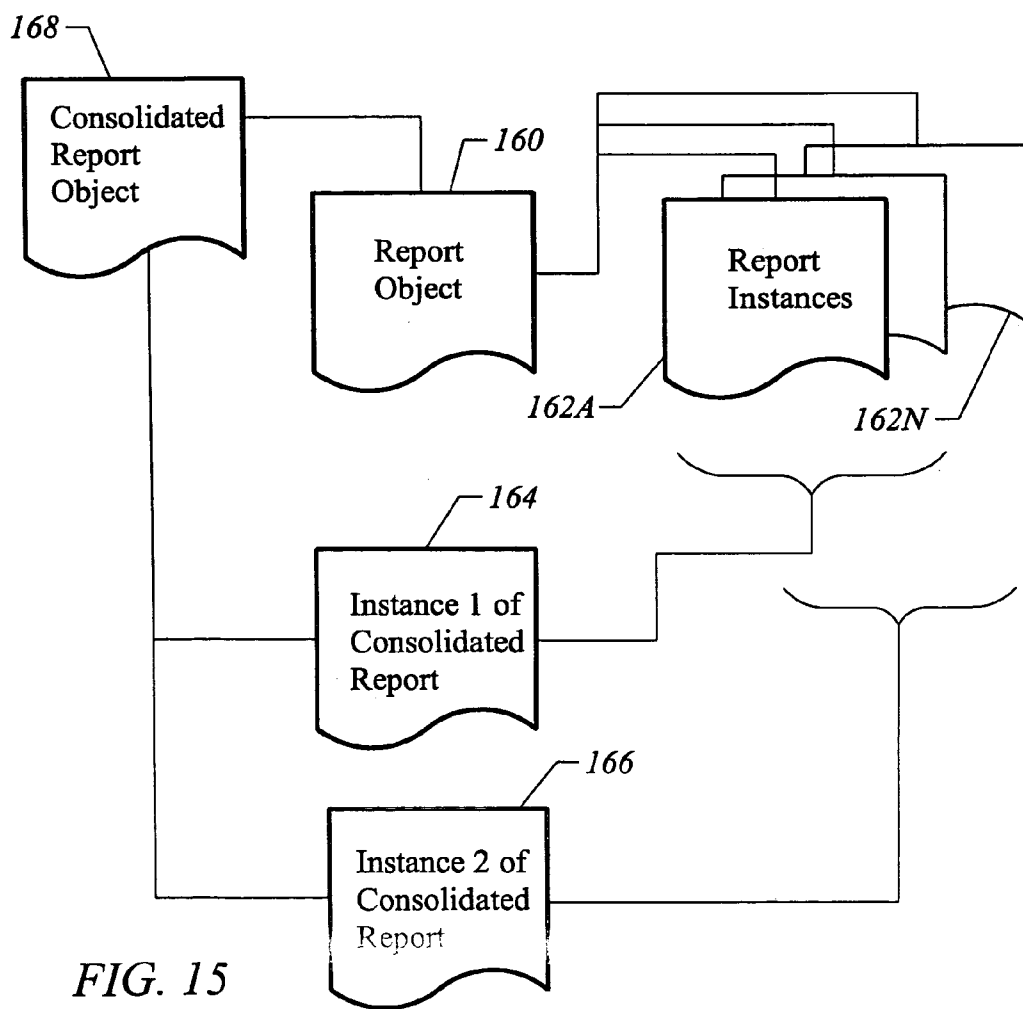
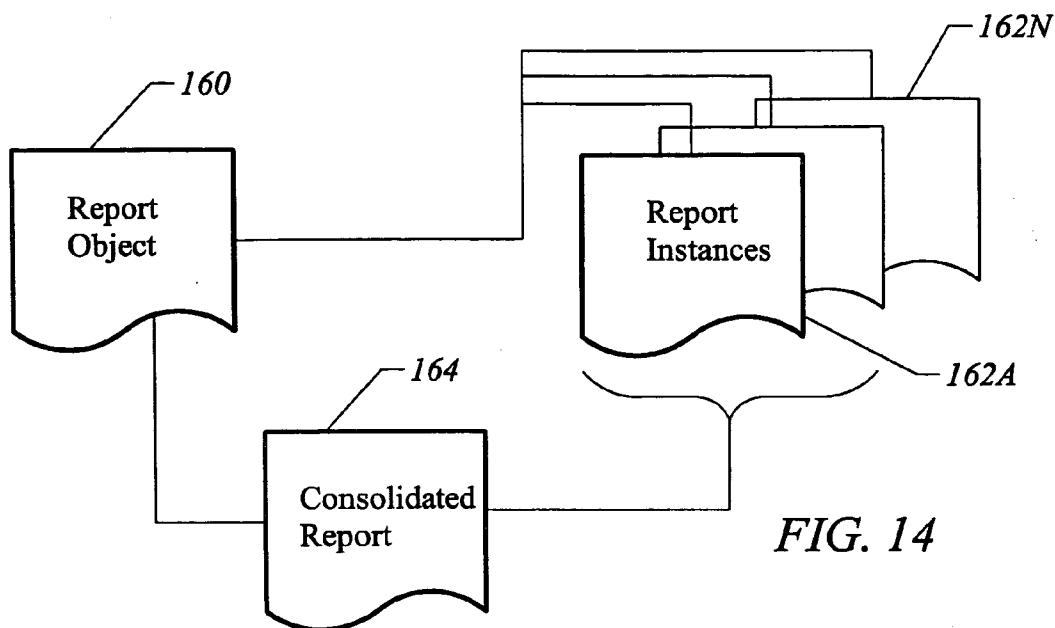


FIG. 13



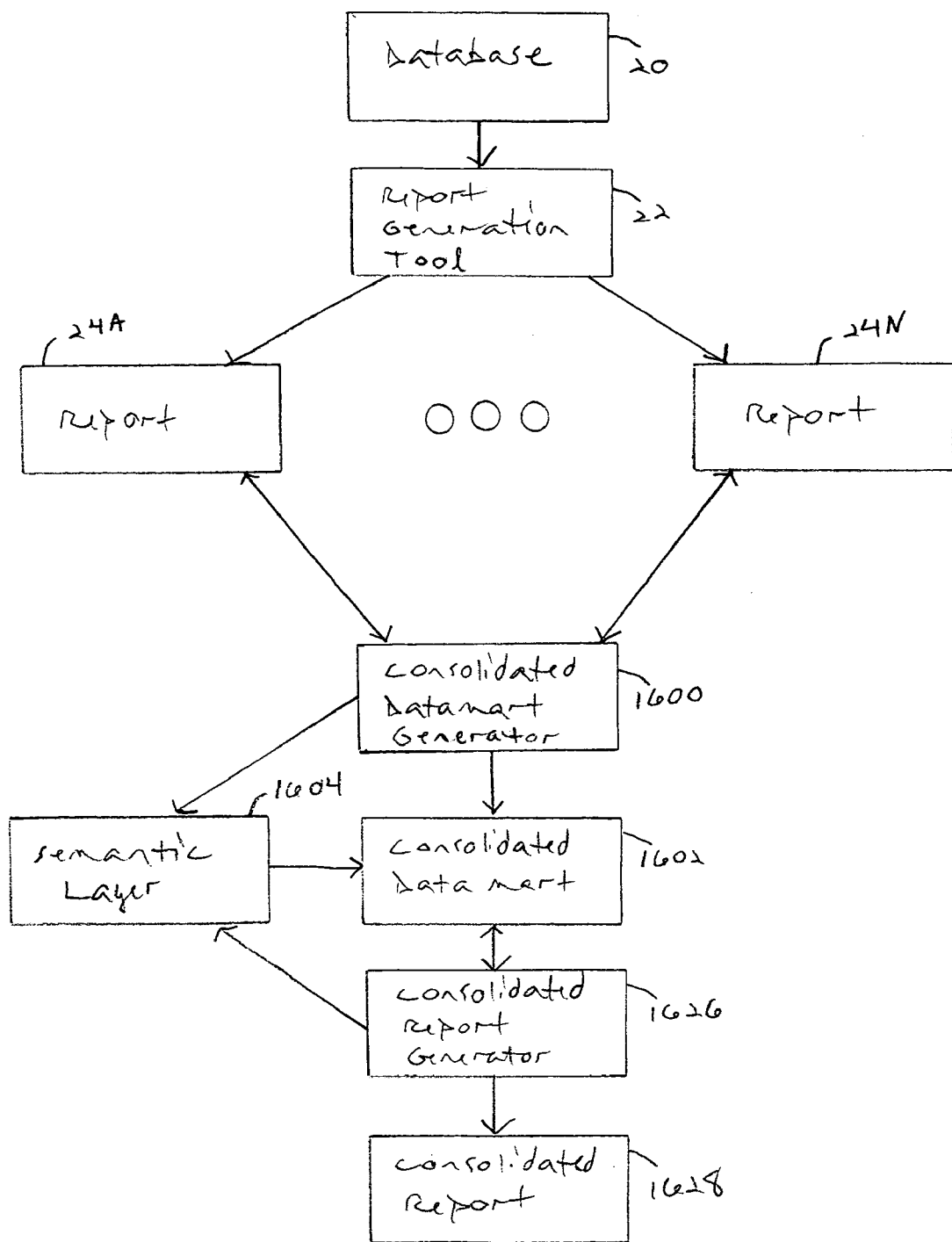


Fig. 16



Corporate Documents

Corporate Categories > All Documents

5 Document(s) [Exit Search](#) [View List](#) [Add to My InfoView](#)

LatesLightSandOvers
 Domain: Document
 From: administrator
 Date: 05/03/2004 01:08:51 PM
 Size: 0 K
 Delete Properties

LatesLightSandOvers.rpt
 Domain: Crystal
 From: Administrator
 Date: 05/03/2004 12:19:39 PM
 History

SupplyChainLatesAndLights
 Domain: Crystal
 From: Administrator
 Date: 02/18/2004 03:03:23 PM
 History

TESales
 Domain: Crystal
 From: Administrator
 Date: 05/11/2004 02:48:52 PM
 History

TES product line
 Domain: Document
 From: administrator
 Date: 05/11/2004 03:19:43 PM
 Size: 28 K
 Edit Delete Properties

1702
 1700

Fig. 17



[Add to My InfoView](#)

TESales

Instance Time:

- 04/01/2004 04:24:19 PM
- 03/01/2004 04:18:56 PM
- 02/01/2004 04:21:35 PM
- 01/01/2004 04:20:31 PM
- 12/01/2003 04:15:56 PM
- 11/01/2003 04:14:49 PM
- 10/01/2003 04:13:37 PM
- 09/01/2003 04:12:38 PM
- 08/01/2003 04:11:35 PM
- 07/01/2003 04:10:31 PM
- 06/01/2003 04:09:26 PM

Run By:

- Administrator
- Administrator
- Administrator
- Administrator
- Administrator
- Administrator
- Administrator
- Administrator
- Administrator
- Administrator
- Administrator

Parameters:

- 2004/04/01
- 2004/03/01
- 2004/02/01
- 2004/01/01
- 2003/12/01
- 2003/11/01
- 2003/10/01
- 2003/09/01
- 2003/08/01
- 2003/07/01
- 2003/06/01

Fig. 18

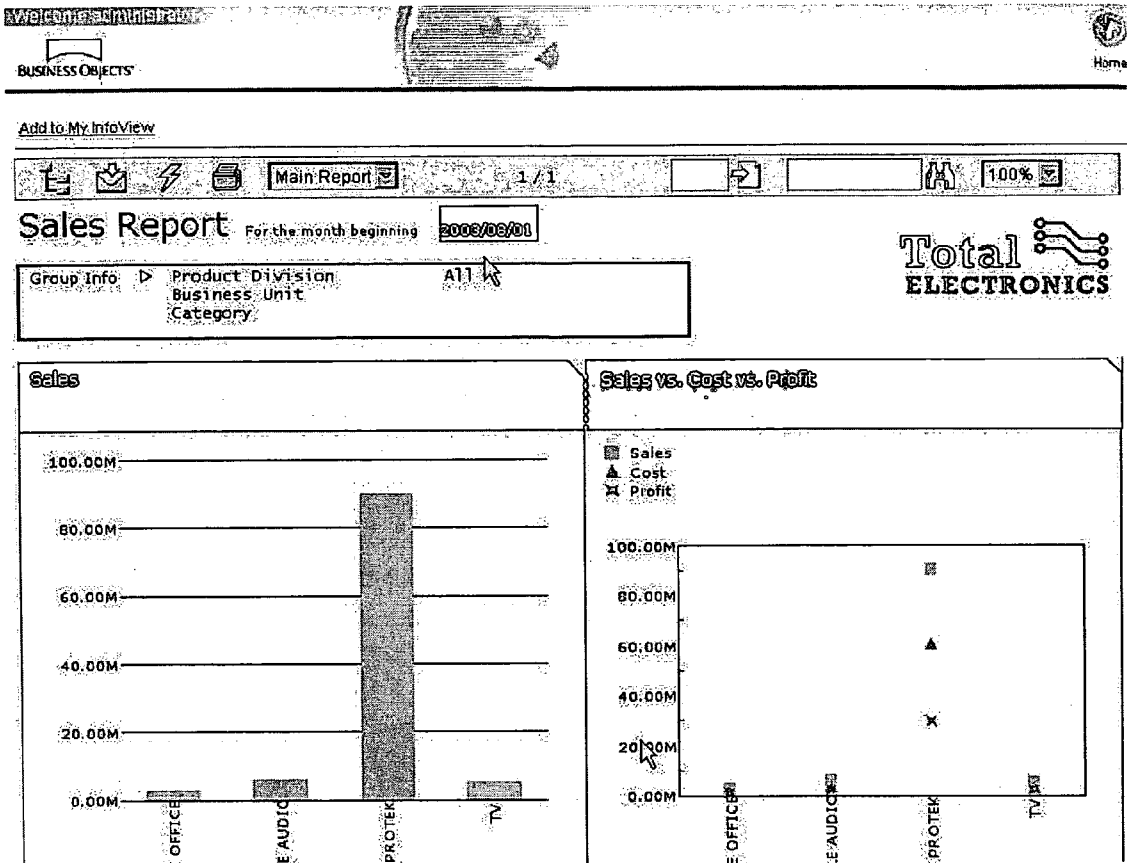


Fig. 19

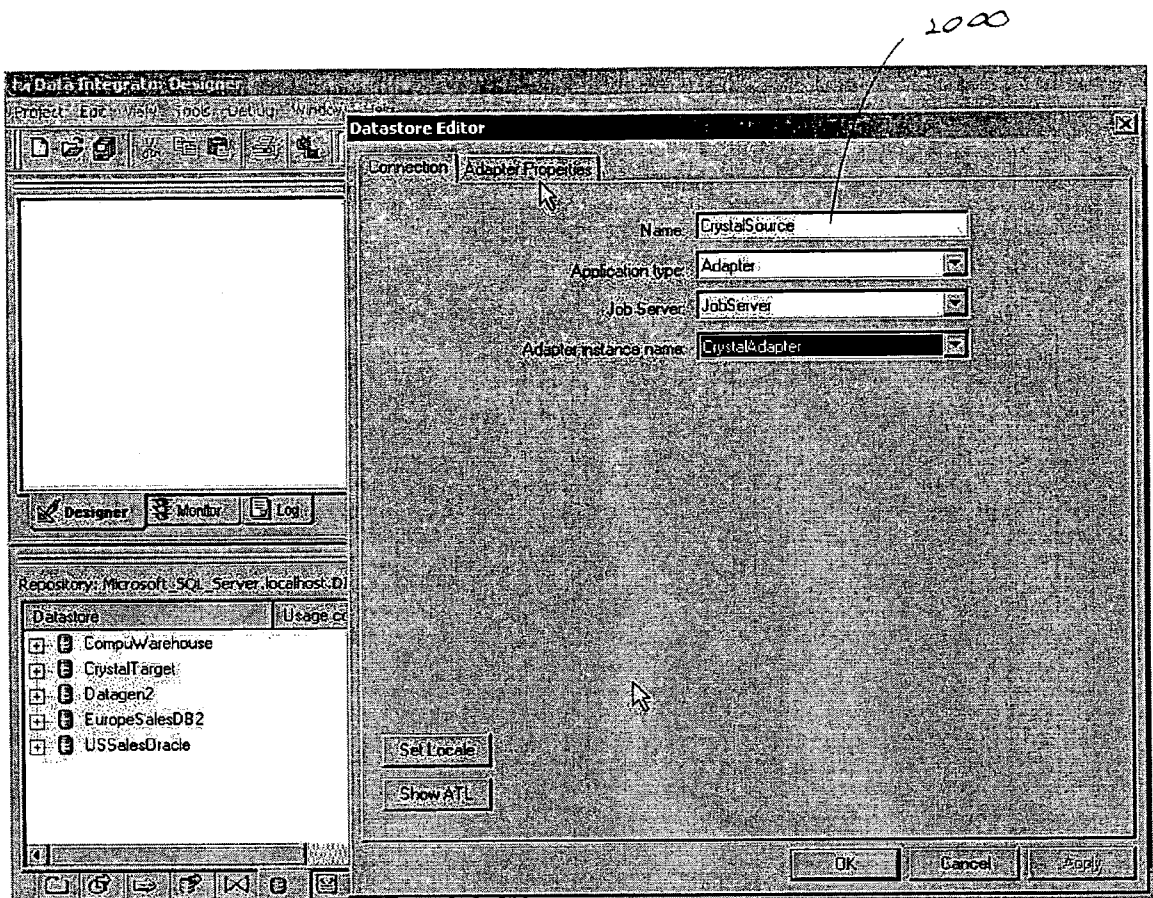


Fig. 20

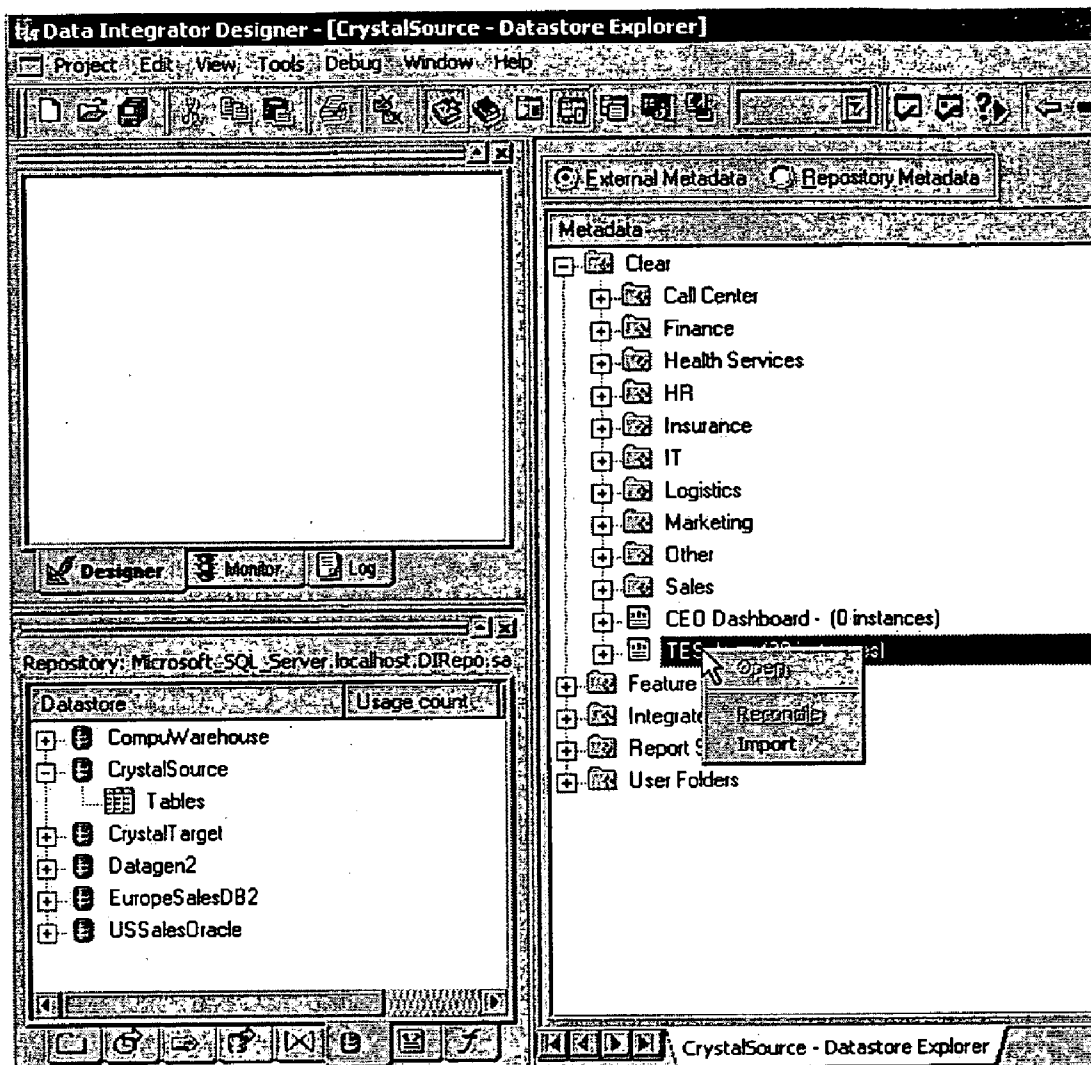


Fig. 21

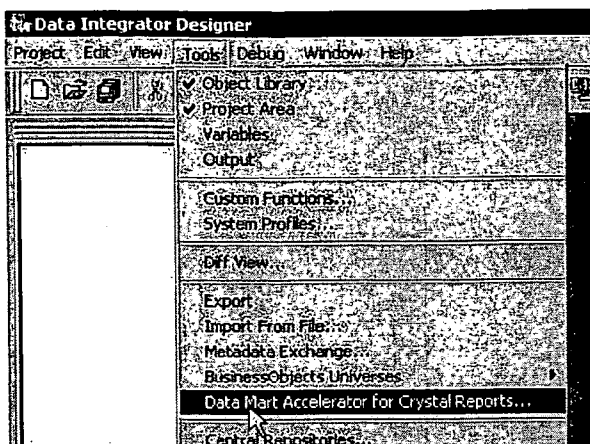


Fig. 22

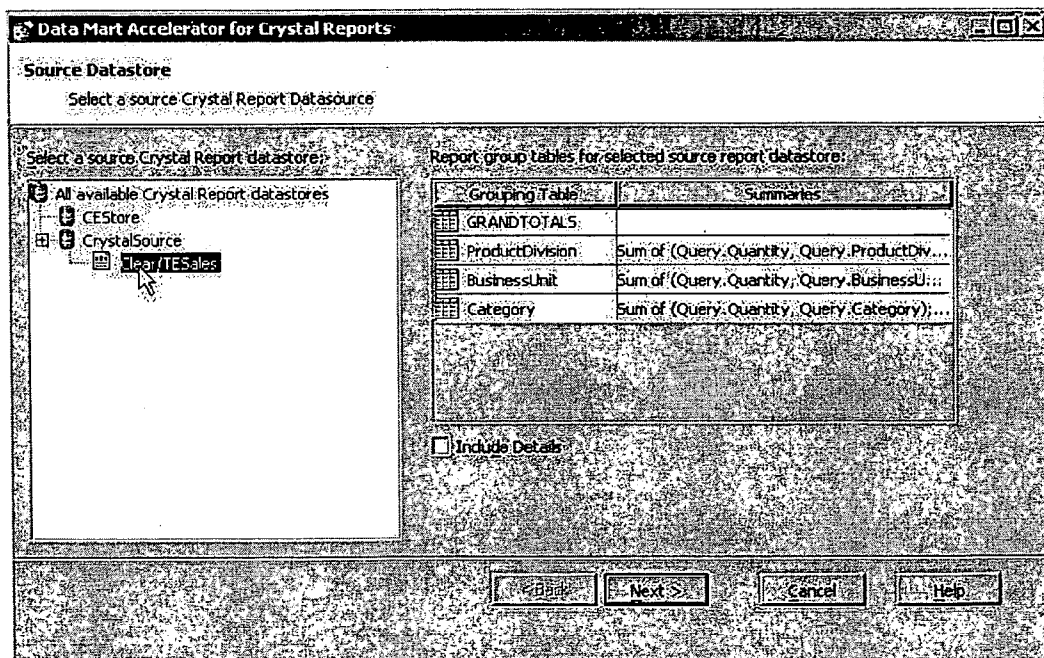


Fig. 23

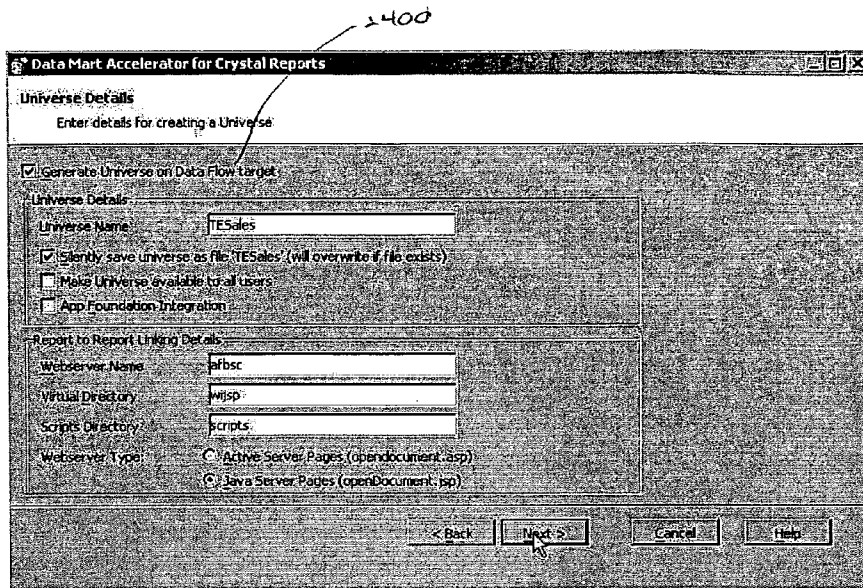


Fig. 24

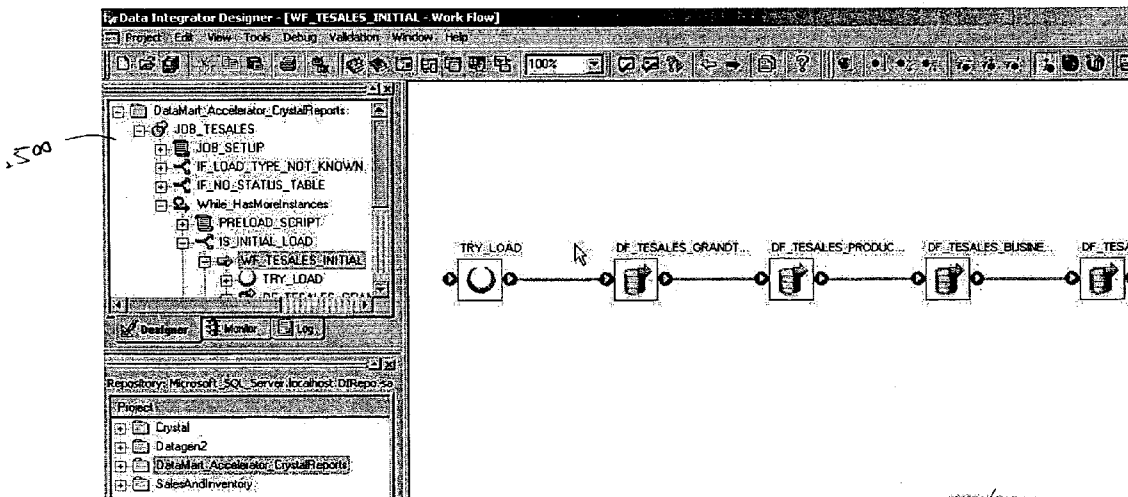


Fig. 25

2502

Data Integrator Designer - [JOB_TESALES_05_27_2004_17_08_39_4 - Job Log]

Project: Edit View Tools Debug Validation Window Help

Designer Monitor Log

Repository: Microsoft SQL Server localhost:0\Replica

Project:

- Crystal
- Datagen2
- DataMart Accelerator CrystalReports
- SalesAndInventory

Job ID	Task ID	Type	Time Stamp	Message
1968	3380	DATAFLOW	05-27-04 17:08:45	Data flow <DF_TESALES_GRANDTOTALS_DELTA> is
1968	3380	DATAFLOW	05-27-04 17:08:51	Data flow <DF_TESALES_GRANDTOTALS_DELTA> is
1968	3380	DATAFLOW	05-27-04 17:08:51	Process to execute data flow <DF_TESALES_GRANDTOT
3380	1968	DATAFLOW	05-27-04 17:08:51	Process to execute data flow <DF_TESALES_PRODUC
3380	1968	DATAFLOW	05-27-04 17:08:52	Data flow <DF_TESALES_PRODUCTDIVISION_DELTA>
3380	1968	DATAFLOW	05-27-04 17:08:53	Data flow <DF_TESALES_PRODUCTDIVISION_DELTA>
3380	1968	DATAFLOW	05-27-04 17:08:53	Process to execute data flow <DF_TESALES_PRODUC
1968	3380	DATAFLOW	05-27-04 17:08:53	Process to execute data flow <DF_TESALES_BUSINES
1968	3380	DATAFLOW	05-27-04 17:08:54	Data flow <DF_TESALES_BUSINESSUNIT_DELTA> is
1968	3380	DATAFLOW	05-27-04 17:08:55	Data flow <DF_TESALES_BUSINESSUNIT_DELTA> is
1968	3380	DATAFLOW	05-27-04 17:08:55	Process to execute data flow <DF_TESALES_BUSINES
3380	1968	DATAFLOW	05-27-04 17:08:55	Process to execute data flow <DF_TESALES_CATEGO
3380	1968	DATAFLOW	05-27-04 17:08:55	Data flow <DF_TESALES_CATEGORY_DELTA> is star
3380	1968	DATAFLOW	05-27-04 17:08:57	Data flow <DF_TESALES_CATEGORY_DELTA> is com
3380	1968	DATAFLOW	05-27-04 17:08:57	Process to execute data flow <DF_TESALES_CATEGO
8084	8082	WORKFLOW	05-27-04 17:08:57	Work flow <WF_TESALES_DELTA> is completed succi
8084	8082	PRINTFN	05-27-04 17:08:57	;\$RUN_LAST_EXTRACT_TIME: 2004-04-01 16:24:19.0
8084	8082	PRINTFN	05-27-04 17:08:57	;\$BASE_EXTRACT_TIME: 2004-04-01 16:24:19
8084	8082	PRINTFN	05-27-04 17:08:57	New Record Count: 0
8084	8082	JOB	05-27-04 17:08:57	Job <JOB_TESALES> is completed successfully.

Fig. 16

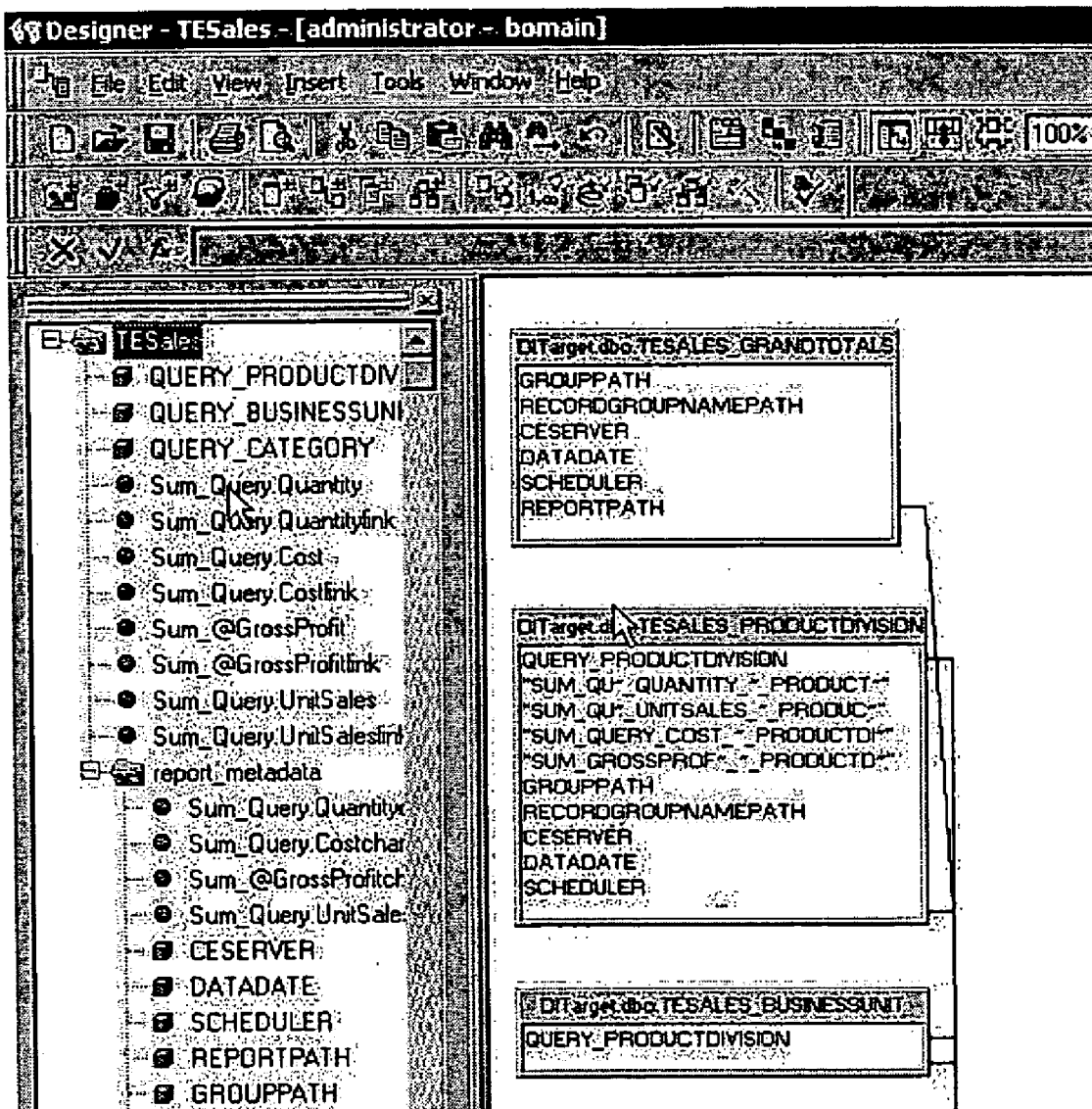


Fig. 17

Business Objects
 Home My Info View Options
 Edit Save Send View in PDF Format Add to My Info View Last refresh date: 05/27/2004:03
 TESales Trend

Unit Sales Trend Last 28 Months

- HOME OFFICE
- ANSWERING MACHINES
- COMMUNICATION DEVICES

DATE	Units Sales by Month
1/1/02	148718
2/1/02	163717
3/1/02	231833
4/1/02	233843
5/1/02	353518
6/1/02	261254
7/1/02	226572
8/1/02	201072
9/1/02	258495
10/1/02	180629
11/1/02	167238
12/1/02	195767

2800

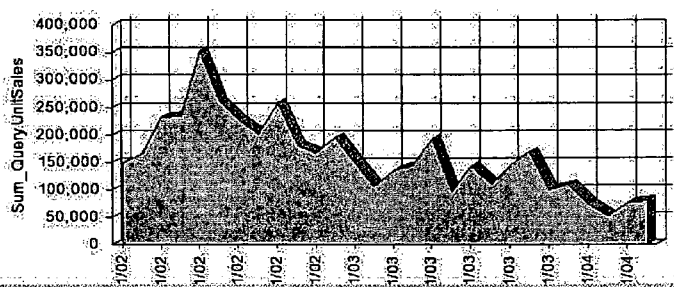


Fig. 28

7/1/02	226572
8/1/02	201072
9/1/02	258495
10/1/02	180629

Fig. 29

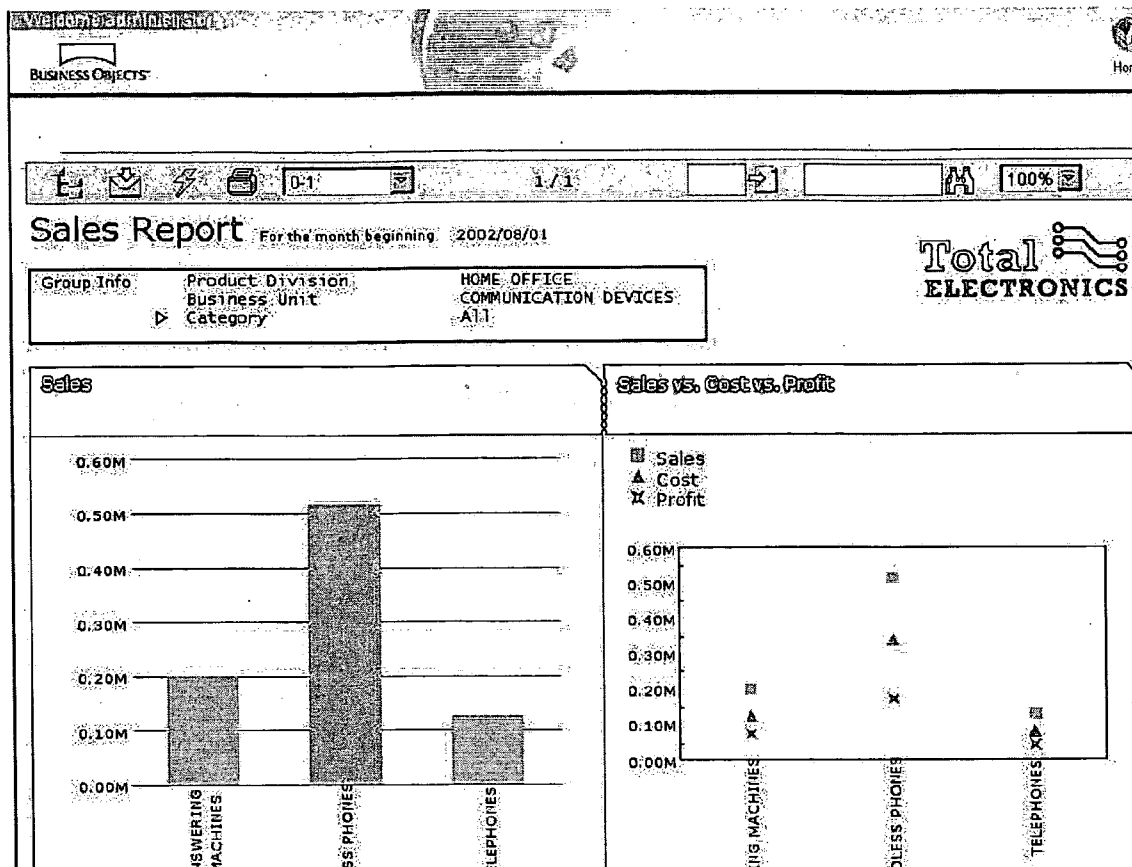


Fig. 30

APPARATUS AND METHOD FOR CREATING NEW REPORTS FROM A CONSOLIDATED DATA MART

[0001] This application is a continuation-in-part of pending U.S. Ser. No. 10/328,744, filed Dec. 23, 2002, entitled "Apparatus and Method for Creating New Reports from Discrete Reports".

BRIEF DESCRIPTION OF THE INVENTION

[0002] This invention relates generally to the generation of reports. More particularly, this invention relates to a technique for using reports as a data source in order to create consolidated reports based upon individual reports.

BACKGROUND OF THE INVENTION

[0003] There are a number of commercially available products to create reports from data stored in a database. Business Objects Americas of San Jose, Calif., sells a number of widely used report generation products, including Crystal Reports™, Crystal Analysis™, Crystal Enterprise™, and Business Objects Enterprise™.

[0004] Known report generation tools access a database each time a report needs to be generated. This can result in large numbers of database accesses that slow down the report generation process. In addition, since a single database is used, it is difficult to decentralize database activity.

[0005] Another limitation associated with existing report generation tools is that the creation of a new form of report commonly requires the rebuilding of the database schema, which can be complex and time consuming. Another problem with existing report generation tools is that they have difficulty merging data from multiple databases into a single report. This problem is especially acute in the case where the databases are from different vendors (e.g., Oracle®, IBM®, Microsoft®).

[0006] Databases have their data updated on a regular basis. While this is important from the standpoint of data consistency, it creates difficulties in obtaining snapshots of data at different points in time.

[0007] In view of the foregoing, it would be highly desirable to provide an improved technique for generating reports to overcome some of the limitations associated with existing report generation tools.

SUMMARY OF THE INVENTION

[0008] The invention includes a computer readable memory with a consolidated data mart generator to generate a consolidated data mart based upon an analysis of a repository of individual reports. A report generation tool produces a report via access to the consolidated data mart.

[0009] The invention also includes a method of forming a report by analyzing a repository of individual reports, generating a consolidated data mart based upon data collected during the analyzing, and producing a report based upon information within the consolidated data mart.

[0010] The invention includes an alternate method of forming a report wherein a report repository is defined with individual reports produced from database information. Selected data is loaded from various individual reports of the

report repository to form a consolidated data mart. A report based upon information within the consolidated data mart is then produced.

[0011] The invention provides a technique that allows data from individual reports to be accessible by standard reporting tools. That is, the selection of data from individual reports to form a consolidated data mart results in a data repository that can be used by standard reporting tools. The invention facilitates the creation of reports that show trends across data found in various reports. The invention is able to access and process snapshots of data. The invention allows the merging of data from multiple databases, having either similar or disparate formats. In addition, the invention facilitates the decentralization of database computational activity.

BRIEF DESCRIPTION OF THE FIGURES

[0012] The invention is more fully appreciated in connection with the following detailed description taken in conjunction with the accompanying drawings, in which:

[0013] FIG. 1 illustrates the operation of consolidated report generation in accordance with an embodiment of the invention.

[0014] FIG. 2 illustrates processing operations performed in accordance with an embodiment of the invention.

[0015] FIG. 3 is an example of portions of reports used to create a consolidated report in accordance with an embodiment of the invention.

[0016] FIG. 4 illustrates a user interface that may be used to create a consolidated report in accordance with an embodiment of the invention.

[0017] FIG. 5 illustrates another user interface that may be used to create a consolidated report in accordance with an embodiment of the invention.

[0018] FIGS. 6-9 illustrate specific reports that may be used to create a consolidated report in accordance with an embodiment of the invention.

[0019] FIG. 10 illustrates a consolidated report created from the information of the specific reports of FIGS. 6-9 in accordance with an embodiment of the invention.

[0020] FIG. 11 illustrates the operation of expanding information in a consolidated report in accordance with an embodiment of the invention.

[0021] FIG. 12 illustrates the result of drilling through information within the report of FIG. 11 to obtain a detailed base report.

[0022] FIG. 13 illustrates a computer network architecture that may be utilized to implement embodiments of the invention.

[0023] FIG. 14 illustrates a consolidated report architecture that utilizes a report as a root object in accordance with an embodiment of the invention.

[0024] FIG. 15 illustrates a consolidated report architecture that utilizes a root object in accordance with an embodiment of the invention.

[0025] FIG. 16 illustrates the generation of a consolidated report from a consolidated data mart in accordance with an embodiment of the invention.

[0026] FIGS. 17-30 illustrate various Graphical User Interfaces that may be used to invoke the operations of the invention and to display the results of the operations of the invention.

[0027] Like reference numerals refer to corresponding parts throughout the several views of the drawings.

DETAILED DESCRIPTION OF THE INVENTION

[0028] FIG. 1 illustrates the operation of consolidated report generation in accordance with an embodiment of the invention. In accordance with the prior art, a database 20 is accessed by a conventional report generation tool 22 to produce a set of reports 24A-24N. In the prior art, if a new report is to be created, the report generation tool 22 must be used to access the database 20 to create a new report.

[0029] In accordance with the invention, a consolidated report generator 26 is used to produce a consolidated report 28 based upon the information contained in the previously generated reports 24A-24N. In other words, the consolidated report generator 26 does not access the data in the database 20; rather, the consolidated report generator 26 uses the data in the reports 24A-24N as a data source to produce a new consolidated report 28.

[0030] FIG. 2 illustrates processing operations associated with an embodiment of the invention. Initially, a report repository of individual reports is created or defined from database information (block 30). A report repository is simply a collection of reports. The individual reports may be created with a conventional report generation tool, such as Crystal Reports™, Crystal Analysis™, Crystal Enterprise™, or Business Objects Enterprise™ sold by Business Objects Americas, San Jose, Calif.

[0031] By way of example, FIG. 3 illustrates four individual reports 32A-32D. Each individual report provides information for a quarter of a calendar year. Thus, there is a first quarter report 32A, a second quarter report 32B, a third quarter report 32C, and a fourth quarter report 32D. In this example, each report 32 has a customer field 34, an employee field 36, an employee address field 38, and an orders field 40, as shown in FIG. 3. The orders field 40 has a set of sub-fields, including an order ID field 42, an order amount field 44, a customer ID field 46, a quarter sales field 48, an order date field 50, a required date field 52, a ship date field 54, a courier website field 56, a ship via field 58, a shipped field 60, a Purchase Order number field 62, and a payment received field 64.

[0032] Returning to FIG. 2, the next processing operation is to select consolidated report criteria (block 70). FIG. 4 illustrates a graphical user interface 72 that may be used in accordance with an embodiment of the invention to facilitate this operation. The graphical user interface 72 may be used to display a series of reports in a repository of reports. In this example, the available reports 32A-32D correspond to the reports 32A-32D shown in FIG. 3. In one embodiment of the invention, specific fields in the selected reports are then selected. The graphical user interface 74 of FIG. 5 shows a

set of fields corresponding to the fields illustrated in the exemplary reports of FIG. 3. In this example, the quarter sales field 48 is selected.

[0033] Alternate techniques may be used to select consolidated report criteria. In another embodiment of the invention, a prompt is provided for a data source. For example, the data source may be a report file path or a path of a directory that contains multiple report files. Preferably, a data context for a report path can be defined to limit the amount of viewed information. For example, a special character (e.g., “?”) can be appended to a report path to limit information to selected fields of a report. Thus, for example, assuming a base report grouped by region, to see only the Quarterly sales records for the U.S. in a report, the following report path and data context can be used: c:\Directory Name\Report Name.rpt?datacontext=/Country[US]. This example assumes a base report that is grouped by country and customer. Specifying the sum of sales in a country within the base report results in a consolidated report listing this information. One can generate trend data for all countries (e.g., datacontext=/Country[*]) or trend data for a selected country (e.g., datacontext=/Country[US]).

[0034] In one embodiment of the invention, a consolidated report of the invention is created through the following instruction sequence:

- [0035] 1. On a standard toolbar, click New.
- [0036] 2. In a Reports Gallery, click As a Blank Report and then OK.
- [0037] 3. In a Database dialog box, expand Create New Connection and click OLE DB.
- [0038] 4. From a Provider list, select a Rowset Provider and click Next.
- [0039] 5. In a Data Source field, enter the name of the reports file(s) to use in the consolidated report.
- [0040] 6. Click Finish. (A data source called Reports is added to the OLE DB folder.)
- [0041] 7. Add the Reports data source to the Selected Tables area and click OK.

[0042] At this point, a consolidated data source is ready for use as any other data source for report creation. If the Reports node in the Field Explorer is expanded, the fields from each report specified as a data source may be displayed.

[0043] Preferably, special fields are provided to track specific information about the report fields in the data source. Example special fields include:

- [0044] Report Path—This field shows the path and name of the report for the current record.
- [0045] Group Path—This field shows the group level and record number of the current record in the report.
- [0046] Record Number—This field shows the record number of the current record in the report.
- [0047] Data Date—This field shows the date the data was last refreshed in the report.
- [0048] Data Time—This field shows the time the data was last refreshed in the report.

[0049] Returning now to FIG. 2, the next processing operation is to analyze individual reports within a report repository based upon selected consolidated report criteria (block 80). Executable code is invoked to perform this operation. This results in the generation of a consolidated report (block 82).

[0050] FIG. 3 illustrates a consolidated report 28. In particular, the figure illustrates a consolidated report 28 with a first quarter sales field 90, a second quarter sales field 92, a third quarter sales field 94, a fourth quarter sales field 96, and a total sales field 98, which represents the sum of the individual sales fields. Observe here that the consolidated report 28 was created based upon data in individual reports 32A-32D, instead of accessing a database. Therefore, a new report is available without rebuilding the database schema.

[0051] The consolidated report 28 shows trends across data found in time stamped instances of other reports. Thus, the consolidated report 28 has captured snapshots of data over an extended period of time. It should be further appreciated that the database source of the individual reports used to generate the consolidated report 28 is irrelevant. Thus, the consolidated report 28 can be created from individual reports that were derived from disparate databases. Accordingly, the invention allows the merging of data from multiple databases, having either similar or disparate formats. It can also be appreciated that the invention reduces database accesses as new reports are generated from individual reports, not database accesses. In addition, the invention facilitates the decentralization of database computational activity. For example, individual reports may be created in branch offices and then transmitted to a central office. At the central office, a consolidated report is generated based upon the received reports from the branch offices.

[0052] Returning once again to FIG. 2, a final optional operation is displayed. In particular, an operation may be implemented to drill through to a source report (block 100). Preferably, each field in a consolidated report 28 has an associated link to its source report. By activating this link, the user is returned to the source report, thereby allowing drill down processing. Arrow 102 of FIG. 3 illustrates a link between the first quarter sales field 90 and its corresponding field 48 in source report 32A.

[0053] Now that the general features of the invention have been described, attention turns to a more specific example for the purpose of more fully illustrating the features and advantages of the invention. FIG. 6 illustrates a quarterly sales report. As shown in the design/preview window 103, this sales report specifies quarterly sales for North America (NA), Europe (EU), and the Asia Pacific (Asia Pac). The report window 104 illustrates a breakdown for North American sales by country, including the U.S. and Canada. The report also reflects a total sales amount for North America for the first calendar quarter ending Mar. 31, 2002. Similarly, the report reflects a breakdown for European sales by country, including England, France, and Germany. A total sales volume for the European region for the first quarter is also supplied. Similar information is provided for the Asia Pacific region. FIGS. 7-9 reflect the same information for the subsequent quarters of 2002.

[0054] Using the previously described techniques, a consolidated report can be produced from the individual reports of FIGS. 6-9. The resultant consolidated report is shown in

FIG. 10. The consolidated report 105 of FIG. 10 illustrates quarterly sales and total sales for each region (i.e., Asia Pacific, Europe, and North America). The tabular numeric data is also supplied in a graph 106 in this example.

[0055] In accordance with an embodiment of the invention, the reports used to generate the regional data can be invoked. By way of example, FIG. 11 illustrates an expanded regional data report 107. In this example, the expanded regional data is for Europe and includes individual quarterly and total sales for England, France, and Germany.

[0056] In accordance with an embodiment of the invention, further expansion or drill through to source reports can be accomplished. For example, if the link associated with the third quarter sales for France is activated, then the user receives the report of FIG. 8. If the user activates the France link 108 of FIG. 8, then a detailed sales report for France in the third quarter is supplied, as shown in FIG. 12. The detailed report 109 of FIG. 12 provides information on the individual sales transactions that produced the third quarter sales total (i.e., \$765,332.34) for France.

[0057] FIG. 13 illustrates a computer network architecture that may be utilized to implement embodiments of the invention. The computer network architecture 110 includes a client computer 112. The client computer has a central processing unit 114 connected to a network connection circuit 116 via a bus 118. The network connection circuit 116 is also connected to a network transport medium 119, which may be any wired or wireless transport medium. A set of input/output devices (not shown) is also attached to the bus 118 to allow a user to input and view data.

[0058] A memory 120 is also connected to the bus 118. The memory 120 stores a set of executable programs. One executable program is a query module 122 (e.g., a report generation tool). The query module 122 utilizes standard techniques to produce a set of reports 124A-124N.

[0059] The query module 122 may access one or more databases resident on the client computer 112. However, in this example, the query module 122 accesses one or more databases resident on server computer 130. Server computer 130 includes a central processing unit 132 connected to a network connection circuit 134 via a bus 136. The network connection circuit 134 is also connected to the network transport medium 119. A set of input/output devices (not shown) is also attached to the bus 136 to allow a user to input and view data. A memory 138 is also connected to the bus 136. The memory 138 stores one or more databases 140A-140N.

[0060] A consolidated report generator 150 may be executed from either the server computer 130 or the client computer 112. In this example, the client computer 112 includes a consolidated report generator 150 with executable instructions to implement the operations described herein. This results in the creation of one or more consolidated reports 152A-152N. Additional consolidated reports may be formed from the information contained in individual consolidated reports.

[0061] FIG. 14 illustrates a consolidated report architecture that utilizes a report as a root object in accordance with an embodiment of the invention. A report object 160 is used to produce report instances 162A-162N. The consolidated report generator 150 uses the report object 160 to define

fields for a consolidated report, as discussed in connection with FIGS. 3-5. The consolidated report generator 150 also produces a consolidated report 164 based upon data contained within the report instances 162A-162N, as previously discussed.

[0062] FIG. 15 illustrates a consolidated report architecture that utilizes a root object in accordance with an embodiment of the invention. A report object 160 is used to produce report instances 162A-162N. The consolidated report generator 150 is used to produce a first instance of a consolidated report 164 and a second instance of a consolidated report 166 based upon the data in the report instances 162. A consolidated report object 168 operates as a parent object to the consolidated report instances 164, 166.

[0063] Different object architectures can be used to implement various consolidated report functionality. For example, consolidated reports can be programmed to run at a scheduled time. At the scheduled time, the new object inherits the superset of all instances of the parent. Security may also be implemented through various object architectures. For example, a user may be prohibited from generating a consolidated report unless the individual has access to the parent object.

[0064] The consolidated report generation techniques of the invention may employ any number of architectures. FIG. 16 illustrates one alternate architecture. As in the case of FIG. 1, a database 20 is accessed by a report generation tool 22 to produce a set of reports 24A through 24N. Then, instead of using a consolidated report generator 26 to produce a consolidated report 28, as shown in FIG. 1, a consolidated data mart generator 1600 is used to produce a consolidated data mart 1602. The consolidated data mart generator 1600 includes executable instructions to select data from individual reports 24 to produce a consolidated data mart, which may store the selected data in a table or similar structure. Thus, the consolidated data mart is a data repository that stores data selected from report instances. The consolidated data mart provides formatted data that is accessible by any number of report generation tools. Thus, the consolidated data mart operates to make data from individual reports accessible to a variety of report generation tools.

[0065] The consolidated data mart generator 1600 may be configured to provide incremental updates to the consolidated data mart 1602. For example, the consolidated data mart generator 1600 may be configured to incrementally upload data to the consolidated data mart 1602 each time a new report instance is created.

[0066] The consolidated data mart generator 1600 may also include executable instructions to produce a semantic layer 1604, which includes metadata associated with the data in the consolidated data mart 1602.

[0067] A consolidated report generator 1626 then produces a report 1628 by accessing the consolidated data mart 1602. That is, unlike previous embodiments in which a consolidated report generator 26 accessed individual reports 24, the consolidated report generator 1626 of this embodiment accesses the consolidated data mart 1602, which stores data from individual reports 24. The consolidated report generator 1626 is not a specialized tool, rather it may be a standard report generator. The term consolidated report

generator 1626 is used to denote that the resultant report includes data that has been consolidated from various report instances.

[0068] The consolidated report generator 1626 may also access the semantic layer 1604 in the process of generating a consolidated report 1628. The consolidated report 1628 typically reflects the differences in data between different report instances.

[0069] In one embodiment, the report instances 24 contain metadata for the report and historical data content, which is preserved as a snapshot of how a business is performing. For example, with key financial data, the information in a set of report instances can satisfy the purpose of establishing an audit trail.

[0070] The history of report executions captures key information requirements for operational metrics of a business. Because standard corporate reports generally access transactional systems directly, and because these reports are tied closely to people's job responsibilities, these reports contain the numbers and data with which everyone is familiar. Perhaps more significantly, then, data in report instances can be used to establish simple, personalized, trending and correlation analyses for a wide range of users who need to read past reports. Currently, one must manually copy data into spreadsheets in order to examine trends or to perform a tracking analysis. The consolidated data mart 1602 obviates this manual operation. The consolidated data mart 1602 formats data from individual report instances in such a manner that the data can be consumed by other applications or tools that could not have otherwise utilized the data from individual report instances as a data source.

[0071] It is theoretically possible to expose report instances directly as a database source (e.g., an OLEDB data source) in order to extract historical data. However, this approach would be severely restricted by performance and scalability issues that could not be overcome with currently available technologies. The embodiment of FIG. 16 not only makes it possible to rapidly and efficiently facilitate consolidated reporting, it also allows a user to drill through to a particular report instance to retrieve detail information.

[0072] The current embodiment allows report instances to be efficiently targeted as a data source for data mart construction. This embodiment is scalable and has high performance. This embodiment of the invention also provides for incremental loading. Users can schedule reports and pick up the delta (i.e., the changes) between instances to execute trending and correlation analyses on scheduled report instances. In one embodiment, the system maintains metadata to identify where the report and report data originates.

[0073] The consolidated data mart generator may be configured in any number of ways. The following description relates to one embodiment of the consolidated data mart generator 1600 that has been commercialized by Business Objects Americas of San Jose, Calif. The consolidated data mart generator 1600 may be implemented with the Crystal Data Adapter™, which is a plug-in to the Business Objects Data Integrator Adapter™ software developer kit sold by Business Objects Americas. The Crystal Data Adapter browses a report repository (e.g., a Crystal Enterprise system) and selects reports for which grouping schema can be imported. Internally, the Crystal Data Adapter uses the Java

Crystal Enterprise™, Java Business Objects Enterprise™ and/or Java Enterprise Report Object Model™ software developer kits, all sold by Business Objects Americas, to find available reports and to create metadata on their grouping structure.

[0074] Executable instructions associated with the consolidated data mart generator **1600** query the Data Integrator repository to obtain a list of available Crystal Data Adapter data stores (and the imported report metadata). A list of available target data stores (e.g., data marts) to which summarized instance data can be written is then queried. Report instance data is then read and written (according to the grouping schema) to a specified data mart.

[0075] The consolidated data mart generator **1600** may also be configured to produce a semantic layer **1604**. For example, the consolidated data mart generator **1600** may be configured to generate a Business Objects Universe on top of the target data mart. This may be implemented using the Business Objects Designer software developer kit. The universe is aware of the aggregation structure of the report summary fields in the data mart. The universe also contains dynamically generated hyperlinks, which link each summary value back to the original report instance (at the exact location in the report from which the summary value was extracted). These hyperlinks are also aggregate aware and dynamically link to the summary level being viewed in the report.

[0076] The operation of the consolidated data mart generator **1600** is more fully appreciated with the following example. **FIG. 17** illustrates a set of corporate documents that a user may access. The corporate documents include a “TESales” report **1700**. Note that there is a link **1702** entitled “History” associated with the report. This indicates that the report has historical instances that can be accessed through a drill down operation. As previously discussed, a report instance is a snapshot in time of the operational data from which it is derived. Most companies run their reports on a scheduled basis, such as every night, week, or month. Clicking on the history link **1702** results in a display of the historical instances of the report, as shown in **FIG. 18**. Observe in **FIG. 18** that a report was generated on the first day of each month. A user may select a report instance to view the operational (sales) data captured on a specified date. **FIG. 19** illustrates one such report, corresponding to the Aug. 1, 2003 report selected from **FIG. 18**.

[0077] A consolidated data mart **1602** may be formed through the following operations. A consolidated data mart generator **1600** may be invoked, as shown in **FIG. 20**. **FIG. 20** illustrates a consolidated data mart generator **1600** in the form of the previously discussed, commercially available, Data Integrator. A source of reports, in this case, “Crystal Source”**2000** is specified.

[0078] **FIG. 21** illustrates information associated with the specified source of reports. In this example the TESales” report is selected to be integrated or imported into a data mart, as shown in **FIG. 21**.

[0079] **FIG. 22** illustrates the selection of a module of the consolidated data mart generator **1600**. In particular, the figure illustrates the selection of a data mart accelerator from a tools drop down window, which results in the GUI of **FIG. 23**. The “TESales” report is once again selected, as shown

in **FIG. 23**. **FIG. 23** illustrates that there are four aggregate tables (Grand Totals, Product Division, Business Unit, Category) associated with the report.

[0080] As previously discussed, the consolidated data generator **1600** may be configured to produce a semantic layer **1604**. **FIG. 24** illustrates one technique for generating an aggregate aware universe. In particular, **FIG. 24** illustrates the selection of a field **2400** that generates a universe based on a data flow target.

[0081] **FIG. 25** illustrates the output produced after the data mart accelerator of **FIG. 22** is executed. **FIG. 25** illustrates a repository **2500** with a “JOB_TESALES”. Panel **2502** illustrates a series of tables forming a data mart formed in response to the foregoing processing. **FIG. 26** illustrates that data from the TESales report instances have been moved into several target tables.

[0082] **FIG. 27** illustrates the TESales universe. **FIG. 27** illustrates tables containing report instance data including date data. The date information is important in helping end users perform trending analyses.

[0083] A consolidated report generator **1626** may then be invoked to create reports from the consolidated data mart. **FIG. 28** illustrates a TESales trend report showing unit sales trends for the last 28 months. Entries **2800** of **FIG. 28** are enlarged in **FIG. 29**. Each of these entries may be selected to invoke the report instance corresponding to the selected data. **FIG. 30** illustrates the underlying Aug. 1, 2002 sales report selected in **FIG. 29**.

[0084] An embodiment of the present invention relates to a computer storage product with a computer-readable medium having computer code thereon for performing various computer-implemented operations. The media and computer code may be those specially designed and constructed for the purposes of the present invention, or they may be of the kind well known and available to those having skill in the computer software arts. Examples of computer-readable media include, but are not limited to: magnetic media such as hard disks, floppy disks, and magnetic tape; optical media such as CD-ROMs and holographic devices; magneto-optical media such as floptical disks; and hardware devices that are specially configured to store and execute program code, such as application-specific integrated circuits (“ASICs”), programmable logic devices (“PLDs”) and ROM and RAM devices. Examples of computer code include machine code, such as produced by a compiler, and files containing higher-level code that are executed by a computer using an interpreter. For example, an embodiment of the invention may be implemented using Java, C++, or other object-oriented programming language and development tools. Another embodiment of the invention may be implemented in hard-wired circuitry in place of, or in combination with, machine-executable software instructions.

[0085] The foregoing description, for purposes of explanation, used specific nomenclature to provide a thorough understanding of the invention. However, it will be apparent to one skilled in the art that specific details are not required in order to practice the invention. Thus, the foregoing descriptions of specific embodiments of the invention are presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed; obviously, many modifications

and variations are possible in view of the above teachings. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, they thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated. It is intended that the following claims and their equivalents define the scope of the invention.

- 1. A method of forming a report, comprising:
analyzing a repository of individual reports;
generating a consolidated data mart based upon data collected during said analyzing; and
producing a report based upon information within said consolidated data mart.
- 2. The method of claim 1 wherein generating includes incrementally adding information to said consolidated data mart in response to the formation of new individual reports.
- 3. The method of claim 1 wherein producing includes accessing a semantic layer to produce said report.
- 4. The method of claim 1 further comprising creating said repository of individual reports by processing data within a database.
- 5. The method of claim 4 wherein creating includes creating said repository of individual reports as time stamped instances of data within said database.
- 6. The method of claim 5 wherein creating includes creating said repository of individual reports by processing data from a plurality of databases with different formats.
- 7. A method of forming a report, comprising:
defining a report repository with individual reports produced from database information;
loading selected data from various individual reports of said report repository to form a consolidated data mart;
and

- producing a report based upon information within said consolidated data mart.
- 8. The method of claim 7 wherein loading includes loading selected data from a new instance of a report.
- 9. The method of claim 7 wherein producing includes accessing a semantic layer to produce said report.
- 10. The method of claim 7 wherein defining includes creating a report repository with individual reports produced from database information selected from a plurality of databases with different formats.
- 11. A computer readable memory, comprising:
a consolidated data mart generator to generate a consolidated data mart based upon an analysis of a repository of individual reports; and
a report generation tool to produce a report via access to said consolidated data mart.
- 12. The computer readable memory of claim 11 wherein said consolidated data mart generator incrementally adds information to said consolidated data mart in response to the creation of a new report instance.
- 13. The computer readable memory of claim 11 wherein said report generation tool access a semantic layer to produce said report.
- 14. The computer readable memory of claim 11 further comprising a query module to create said repository of individual reports by processing data within a database.
- 15. The computer readable memory of claim 14 wherein said query module processes data from a plurality of databases with different formats.
- 16. The computer readable memory of claim 11 wherein said report generation tool produces a report with links to source data within an individual report of said repository of reports.

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