Ranet UI OLAP

3.9 version

USER GUIDE

2021

Content

1. INTRODUCTION TO RANET TOOLS

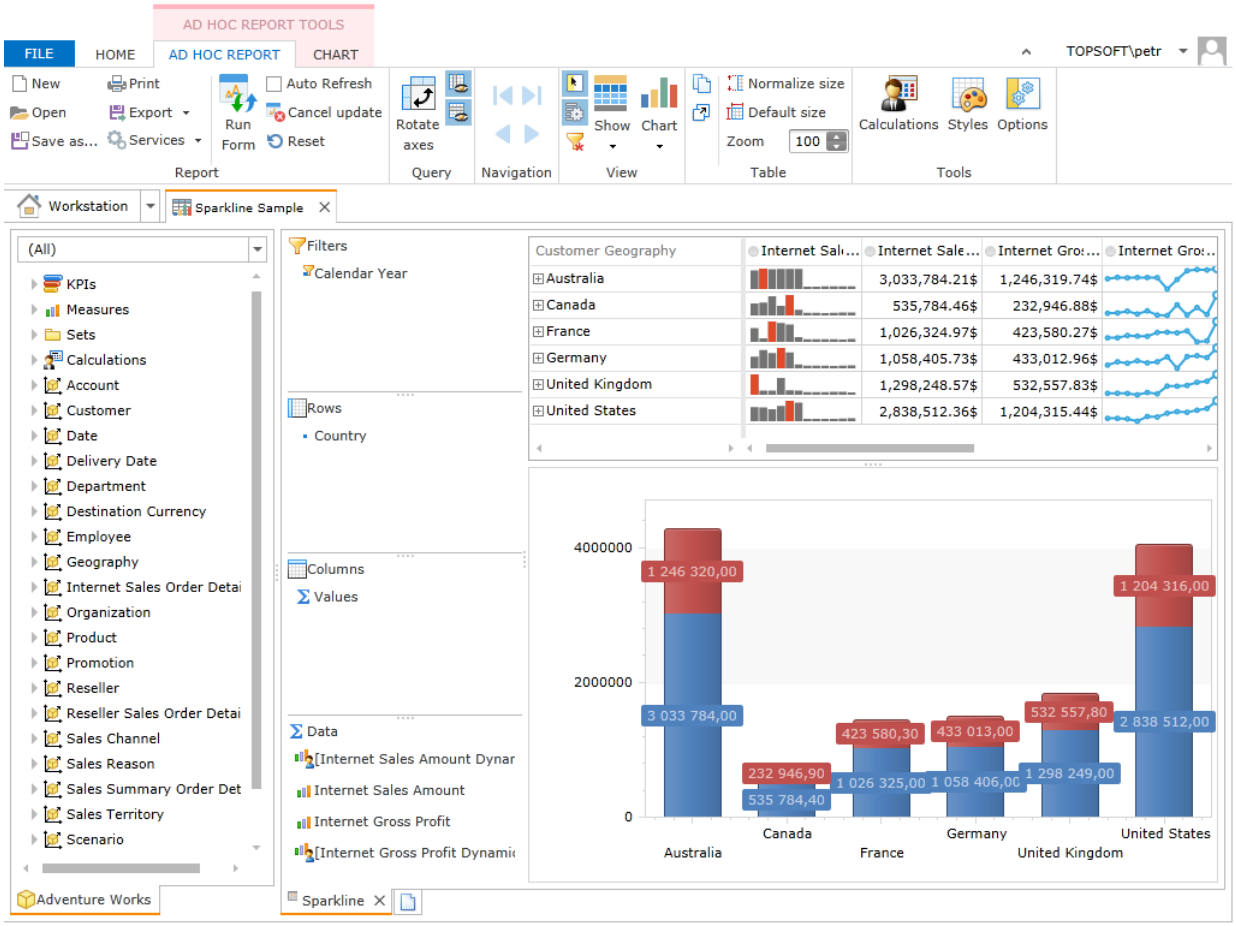
1.1. OVERVIEW

Ranet Data Analysis Tools (hereinafter referred to as Ranet Tools) library is intended to analyze and visualize OLAP (Online Analytical Processing) data.

Visual elements included in Ranet Tools demonstrate high levels of functionality, performance, user friendly interface and design. Pivot table designer is one of the key analytical instruments provided by Ranet Tools to analyze arbitrarily selected data in various forms via pivot tables, geographic maps, and business graphics. The users have no system limitations on data manipulation; everything depends on their skills and experience. It opens vast opportunities for thorough business data analysis in order to make highly rational and well thought managerial decisions based on correct data.

Pivot table designer allows building Ad Hoc Reports by simple Drag and Drop of the required cube (meta)data into the area where the pivot table layout is defined. Expert users can also create custom calculations and use various analytical functions provided by MDX (Multidimensional Expressions query language).

Ranet Tools library can be accessed through the Internet anywhere, anytime, and on any device. Collaborative usage of the library throughout the company helps the users attend to their tasks in a timely manner; it also allows sharing the received knowledge and experience to make team work even more productive. Well-timed receipt of crucial business information can have extremely positive influence on the company's performance and overall efficiency.



Key analytical options are:

- Ad Hoc Reports based on pivot tables for OLAP data analysis;
- Detailing services for data analysis and navigation (including for reports based on manually created MDX queries);
- Comprehensive history of user actions taken while designing the report structure and analyzing its data;
- Flexibly customizable data filters;
- Easy-to-use custom calculations and members;
- Visual styles and samples to customize the view of pivot table data;
- Data export from pivot tables into Microsoft Excel files;
- Charts and diagrams*;
- Geographic maps*;
- Web-server file storage for common report settings;
- Support of web UI and mobile devices.

Note*:

Business graphics is available in HTML5/JS and Silverlight versions. Geographic maps are available in HTML5/JS version.

Ranet Tools library is deeply adapted to Microsoft Analysis Services, but also demonstrates excellent results with other XMLA data sources.
Ranet Tools library is a powerful cross-platform instrument that provides limitless analytical opportunities.

1.2. KEY BENEFITS AND FEATURES

1.2.1. Reports of any complexity

- Creating Ad Hoc Reports based on pivot tables of any complexity using visual designers via simple Drag and Drop operations;
- Wide range of highly functional services for detailed data analysis: Expand, Collapse, Drill down, Drill up, Drill down by, Drillthrough, Cube actions, etc.;
- Built-in custom calculations and cell style editors;
- Custom reports based on arbitrary MDX queries with the same level of interactivity;
- Export/import of report template settings or their separate parts (such as custom styles and calculations).

1.2.2. Flexible filters

- Built-in editors for setting up custom filters, including groups of filters and conditions, aggregating filters (Top/Bottom, Value/Percent/Sum), etc.;
- Efficient work with large cubes and dimensions containing over 100K members.

1.2.3. Complete report design history

Upon any change to the template, the pivot table designer automatically saves and restores all user actions related to the pivot table data analysis. When a new hierarchy is added to the report template, the pivot table is displayed exactly the same as before the addition. This time-saving practice helps the users avoid the necessity of repeating the actions taken while designing the report with the initial structure.

1.2.4. Data Input and What-If Analysis

- Built-in support for services for data input into the cube with the Writeback partition;
- Data modeling and analysis based on the What-If principle;
- Collecting and adding data to the global storage through the Internet (e.g., in financial statements consolidation, planning and budgeting tasks).

1.2.5. Built-in manager for report template settings

- Report template settings are saved on the server for further usage. They can be not only private, but also public (to ensure knowledge exchange);
- The report can be saved with the history of user actions to restore it later exactly in the same state it was in when saved.
- The reports are sorted and grouped into folders to simplify the daily routine. Rapid search of the required report is enabled by filtering.

2. WHAT IS OLAP?

2.1. OLAP OVERVIEW

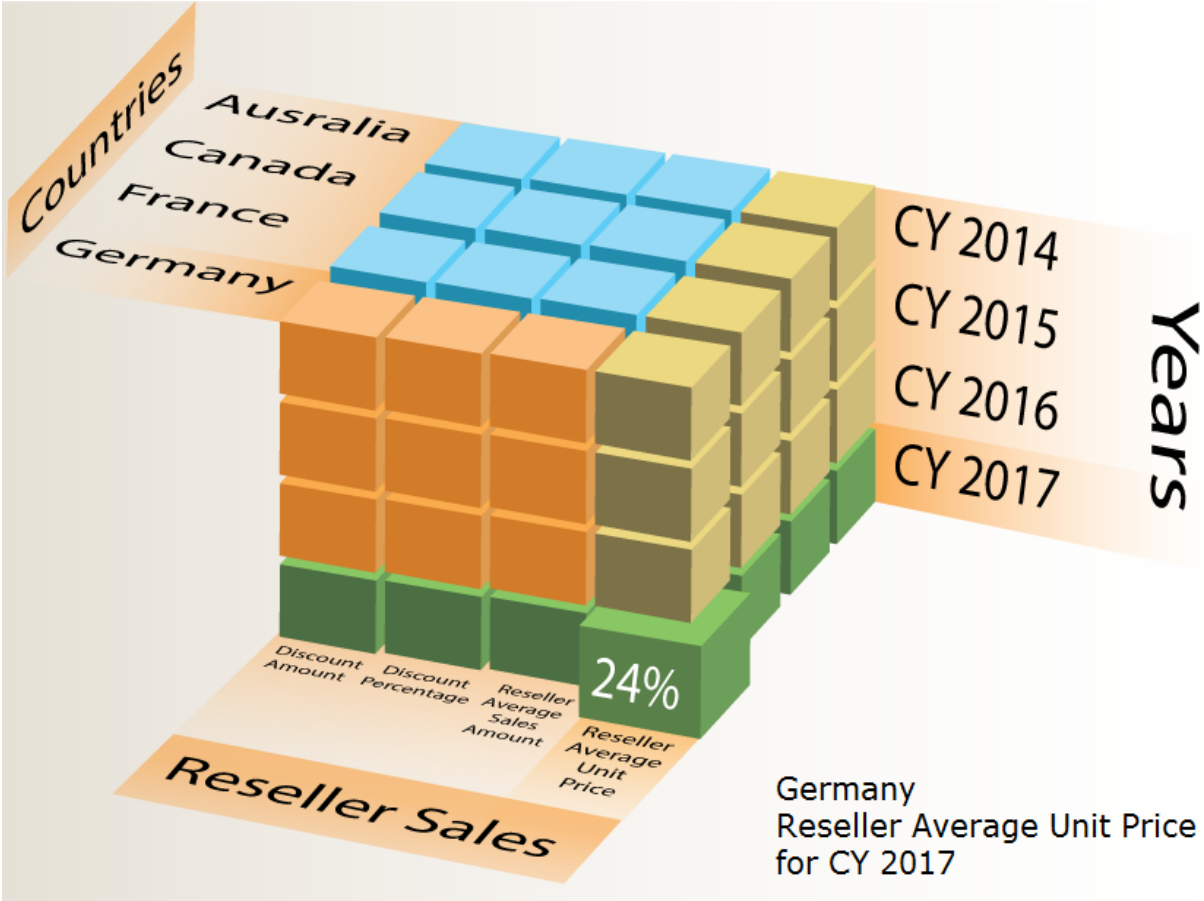
OLAP is based upon a common concept of a multidimensional data model. Investigating any subject area, humans pose questions in various dimensions. People can built a logical model and manipulate it to see the information from different points of view. The data is organized as a multidimensional cube where each edge represents a unique dimension that contains some attributes of an analyzed business process. Dimensions and Measures are the key cube terms defining the axes in a multidimensional coordinate system. The intersection of axes shows quantitative data that characterizes the business process. The user gets a natural and intuitive data model. For instance, when analyzing corporate selling activities, the user can operate the following factors: time, goods and articles, customers in different geographical locations, average order price, and total gain. The cube can be “sliced” in different directions providing aggregate (e.g. for years) or detailed data (for days).

OLAP technology is one of the most valuable and prospective components used in modern BI software for decision making support.

2.2. MULTIDIMENSIONAL CUBES

Multidimensional model can be imagined as a complex outlook containing several independent dimensions used to analyze particular data. Multidimensional cubes define the coordinate system where dimensions are the axes. Multidimensional analysis is a simultaneous data analysis of several dimensions. Facts provide data that quantitatively describe a process and are located at the intersection of the measurement axes. Each collection of members from different dimensions is bound to a separate cell with data.

For example, axes can represent dates, goods, customers, regions, employees, etc. Each collection or tuple (e.g. date-article-customer) is connected to the corresponding cell with the appropriate value. It may be, for instance, total price of all orders delivered to the client over a period of time or anything else. So, there is a solid relation between the analyzed characteristics and their quantitative values.



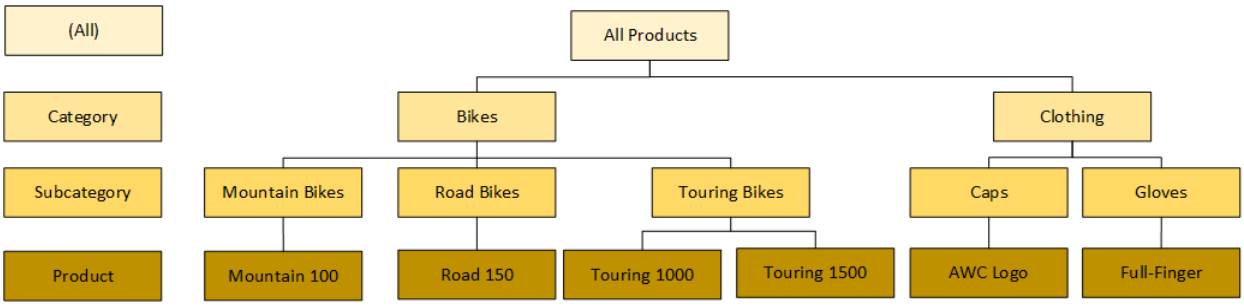
2.3. HIERARCHICAL DATA

OLAP technology is based on multidimensional and hierarchical representation of data. Fundamental feature of OLAP cubes is the focus on data from the hierarchical point of view. Each internal (child, lower) level displays detailed data from the upper (parent, higher) one. Hierarchical (tree) structure is convenient to rapidly display the aggregated data for groups of rows or columns in the pivot table and is also useful to show the detailed data in these groups.

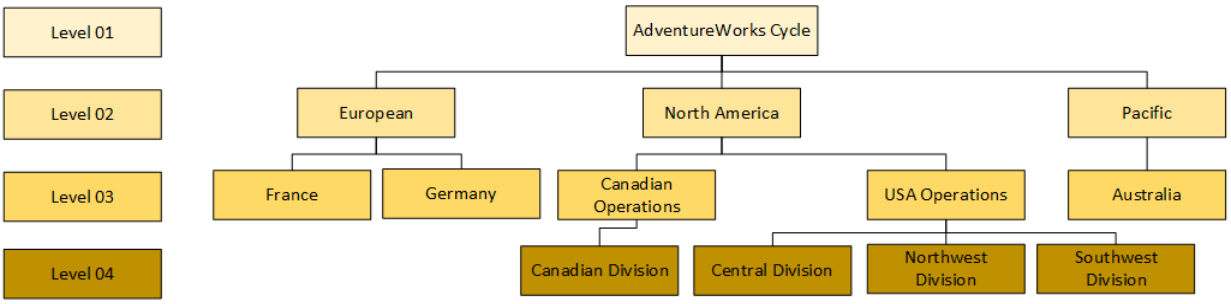
Dimension hierarchies may be multiple and of different types: Parent-Child, User (defined by users), and Attribute (based on dimension attributes). Different hierarchies from the same dimension can be used without limitations to design pivot tables.

To display or hide data in the multidimensional structure, it is enough to click the needed member of the dimension. Depending on the member structure, the query to the data source is automatically modified to provide the user with either detailed or aggregated data.

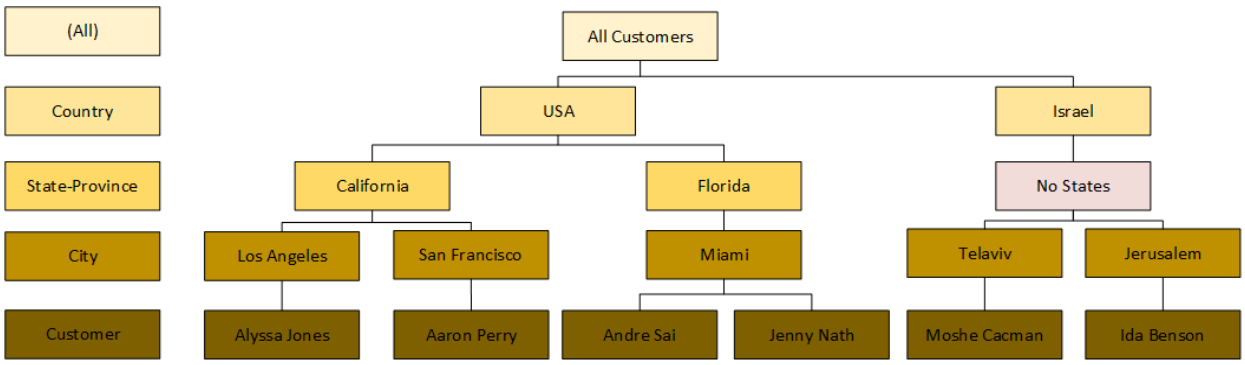
Balanced hierarchy has its members clearly separated by levels. Most typical example is the Time hierarchy that includes different periods (Year, Semester, Quarter, Month, Day). Another example is the geography of customers (Country, City, Customer). As a rule, each country has several cities, and each city has several clients. The same is true for classification of goods (Categories, Subcategories, Articles).



Unbalanced hierarchy is a hierarchy based on the Parent-Child relation. Most common examples here are the hierarchy of corporate departments or branches and the hierarchy of management.



Balanced hierarchies can be not completely symmetric. For example, a more complex hierarchy based on geographic areas can include Country, State/Region, City, District, and Customer. However, not all countries and customers have all levels filled. Some countries have no States/Regions, some cities lack Districts, etc. The difference from unbalanced hierarchies is that the assignment rules and the number of levels are the same.



2.4. TIME PERIODS

Data analysis always takes place at some period of time as the process dynamics is important for users. MDX contains a lot of different functions for manipulating time periods to get the dynamics of the happening processes, analyze past periods, forecast future results, perform statistical analysis and so on. KPIs (Key Performance Indicators) allow estimating the general dynamics and reaching the goals.

2.5. OLAP BENEFITS

2.5.1. High speed data processing

Rapid processing of large amounts of data is the key feature of OLAP technology. A correctly designed cube usually processes a typical user query for interactive data analysis in no longer than 5 seconds.

2.5.2. Practical focus

Data in the cube reflects certain aspects of fiscal and economic corporate activities, such as selling goods, paying counterparties and contractors, size of stocks, etc. Instead of manipulating database table fields, the user interacts with common business categories, e.g.: article, customer, department, employee, etc. Support of multiple languages provides the user with localized data according to the language of the system interface.

2.5.3. Quick start and usability

Users without technical background can easily create Ad Hoc Reports and analyze data on their own (no developer support needed). In most cases, users can also create custom parameters with all the power of MDX without any help required from IT department.

2.5.4. Analysis from aggregated to detailed values

When analyzing OLAP data, users first see consolidated (aggregated) values that can be easily detailed along the hierarchy of the dimension members down to separate facts that influenced the aggregated value. Drill Up and Drill Down services are universal operations for data consolidation and detailing. The Slice function ensures detailed analysis of the data provided by any of the cube dimensions.

2.5.5. Common mathematic calculation point

OLAP technology provides support of internal consistency of data (so called ‘common mathematic calculation point’), when no matter which slices users get the data from and how they manipulate it, they can trust the accuracy of the OLAP data. When using one of the transaction processing systems, the user will most likely have to set several different reports with their own data processing algorithms, which may lead to potential errors.

2.5.6. Storage of data, knowledge and experience

OLAP cubes are usually built upon data storages. They are chronologically consistent, and the data is rarely updated after the fiscal (accounting) period is closed. Large amount of data is accumulated in the storage, providing the opportunity for tracking tendencies, forecasting, modeling, etc.

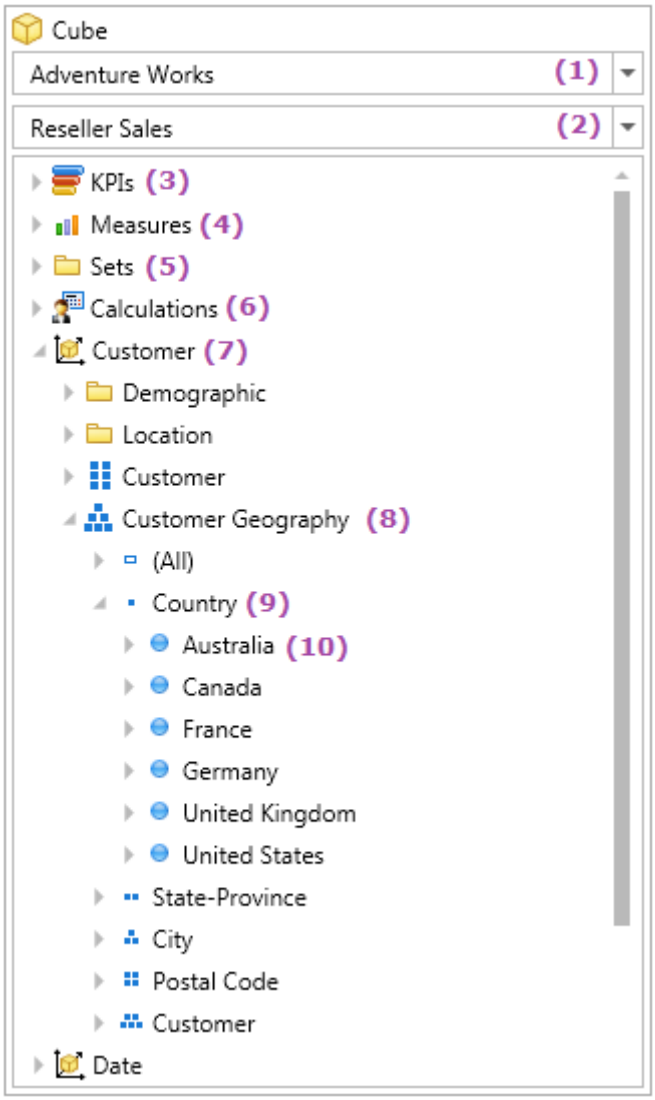
OLAP cubes are used by different user groups from beginners to experts. It allows sharing valuable knowledge and experience throughout the company.

3. CUBE BROWSER

3.1. OVERVIEW

OLAP cubes are data showcases used to analyze particular aspects of fiscal and economic corporate activities. They are practically focused and provide the user with common business objects. The user has the opportunity to build Ad Hoc Reports by manipulating familiar terms regardless of the data sources and structure.

The cube's metadata includes dimensions, hierarchies, levels, values, KPIs, etc. They form the so-called analytical Business Level that provides the user with the opportunity to create reports as interactive pivot tables.



Cube Browser allows the user to view the cube's metadata and data as a hierarchic structure. In this user guide, the metadata elements and the cube data together are called Entities. Using the cube browser, the user can choose Entities to define the structure of the pivot table fields and filter settings.

Note:

In common Microsoft Excel terms, Cube browser Entities are pivot table fields.

Cube entities are divided by types and marked with an icon that corresponds to a particular type of entities in the metadata tree. The user chooses cube entities by Drag and Drop function placing it to the Selection Panel, or the MDX Query Area.

3.2. CUBE ENTITIES

The table below shows the main Entities of the metadata tree and the cube's data alongside their short text overviews and the description of the actions available when designing the pivot table or editing the MDX query.

Cube entity	Overview	Actions
Cube **(1)**	The cube is a part of the analytic server data related to a particular area of work. The cube can also be described as a set of measures and dimensions.	Cube choice allows the user to expand/hide certain dimensions and measures provided by different cubes.
Measure Group **(2)**	The measure group is a collection of measures and dimensions tied together in the cube. Usually, all measures of the group come from the same table of facts.	Measure group choice allows the user to expand/hide certain dimensions and measures tied to different measure groups in the cube.
KPI **(3)**	The Key Performance Indicator (KPI) is a parameter that represents a particular aspect of the corporate activity and is bound to a certain target value or expected result. For higher usability, KPIs can be grouped in folders.	When using Drag and Drop on KPI to place it into the Data area, all 4 parameters of the KPI are added: target value, actual value, status and trend. Each parameter can be dragged and dropped separately from the others. KPI can be used only in the Data area. When dragging KPI into the MSX query area, it is transformed into a function that returns the indicator value.
Measures **(4)**	The Measures dimension is a special type of dimensions.. It is displayed at the top of the dimensions list. All other dimensions are displayed in alphabetical order. The Measures dimension has no hierarchies.	When dragging the measure into the Data or MDX query area, its unique name is selected. It can be used only in the Data area.

	For better usability, measures can be combined in groups.	
Sets **(5)**	Contains named sets created by the cube's developer or administrator. Left button mouse click on the Sets node shows all available named sets.	Can be used only in the Columns and Rows areas.
Calculations **(6)**	Contains custom calculations (named sets and calculated members).	Named sets can be used only in the Columns and Rows areas. Calculated members can be used only in the Data area. To use a calculated member in the Rows or Columns areas, add it into a named set.
Dimension **(7)**	The highest level of the cube structure. The metadata tree displays the changes in alphabetical order. Left button mouse click shows all hierarchies of a Dimension node.	When dragging a Dimension into the Selection panel, it is added as a default hierarchy. When dragging a Dimension into the MDX query area, a unique name of the Dimension is added to the query text. It can be used only in the Filters, Rows, and Columns areas.
Hierarchy **(8)**	Hierarchies organize dimension members into ordered parent-child structures. There are three types of hierarchies: Attribute Hierarchy, User Hierarchy, and Parent-Child Hierarchy. Each type is marked with a special icon. For better usability, hierarchies can be combined in folders. In the metadata tree, hierarchies are displayed inside dimensions in alphabetical order according to the following rule: • Folders • Attribute Hierarchies • User Hierarchies • Parent-Child Hierarchies Left button mouse click shows all levels of a Hierarchy node.	When dragging a dimension hierarchy to the Selection panel or the MDX query area, its unique name is selected. Hierarchies can be used only in the following areas: Filters, Columns, and Rows. It is possible to Drag and Drop hierarchies among these areas.

Level **(9)**	Members of the same level in the hierarchy form levels. Usually (not necessarily), a hierarchy includes the root (All) level. Each next level is marked with a unique icon that shows its level (starting from “1”). Left button mouse click shows all members of a Level node.	When dragging a hierarchy level to the Selection panel or the MDX query area, its unique name is selected. Levels can be used only in the following areas: Filters, Columns, and Rows.
Member **(10)**	Left button mouse click on a Member node displays all its child elements up to the final list member.	When dragging a member into the Selection panel area, the unique name of the member’s parent hierarchy is selected. When dragging a member to the MDX query area, its own unique name is selected. Members can be used only in the following areas: Filters, Columns, Rows. After dragging a member into one of these areas, it is automatically added into the filter settings for the current level or hierarchy.

Read more about metadata cube entities and icon descriptions in the Cube Browser section.

The principles of using the Pivot table designer and its functionality are described in details in the Pivot table designer section.

Dynamic data loading

Sometimes, dimension hierarchies (or their levels) can contain up to several hundreds of thousands of members. It is impossible for the user to operate such volume of data in the Cube browser. That is why we have implemented dynamic data loading . By default, it loads 100 members at a level (can be customized by the system administrator). To inform the user that more data is available than loaded into the tree, there is a special **Load next…** element. This element is displayed at the bottom level in the member tree. Double mouse click on the element loads the next set of data (100 members by default).

Icon	Command	Description
	Load next…	A special member in the tree used to inform the user that NOT all members of the current level are loaded into the metadata tree.
	Load all	A special member in the tree used to inform the user that all members of the current level are loaded into the metadata tree.

4. PIVOT TABLE DESIGNER

4.1. OVERVIEW

Pivot table designer is intended to build Express or Ad Hoc Reports in the form of pivot tables for further analysis of multidimensional data (OLAP cube data). The Designer can be used as either a report-viewing tool or the environment for reports creation. The combination of these two useful opportunities makes the pivot table designer an extremely powerful, convenient, and effective data analysis tool for end users and enterprise software developers.

4.1.1. User Roles

In most cases, Business Intelligence Solutions (BI systems) engage large amount of data and cover several levels of control and management. Each managing level needs different information. Any company using a BI system has the following user groups:

1. **Stakeholders** and **top-managers** are responsible for strategic decision-making. They rarely have enough time to analyze dozens of complicated reports and diagrams. This user group requires simple and accurate reports with key indicators that characterize the corporate activities and can be used to identify the company's "sore spots" and forecast the future tendencies.
2. **Experts** are the employees that influence the decision-making process. This user group includes economists, financial consultants, heads of branches/departments, etc. They require reports with detailed data and interactive analysis options like filtering, multi-level detailing, switching between aggregated and detailed reports, etc.
3. **Analysts** (including **Data Analysis Specialists**) are the users that focus on finding the ways to solve problems in order to achieve the best return on investment. They require the most flexible and multi-functional data analysis tools to detect problems, market trends, current tendencies and so on.

This division is theoretical, and the demands of different user groups can overlap. That is why the opportunity to create reports focused on a particular user or group of users allows the employees to concentrate on most important work aspects, save a lot of time, and find better solutions.

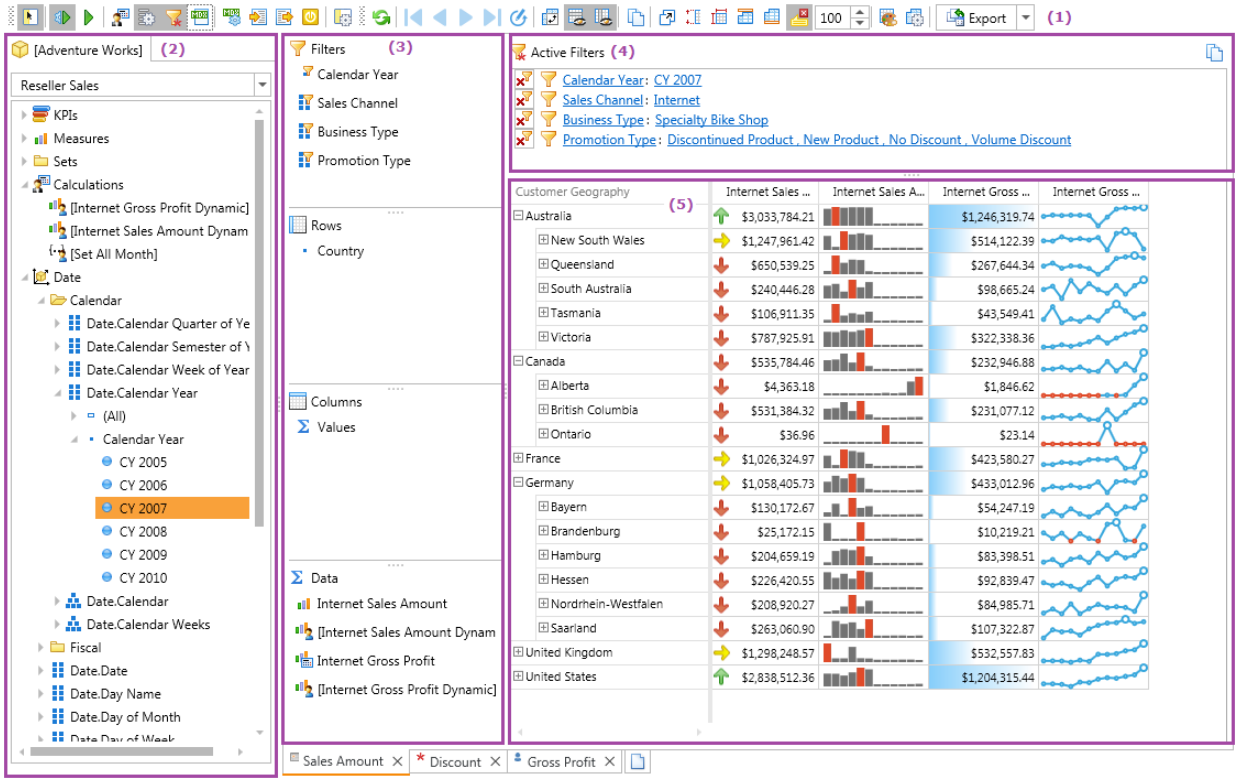
Pivot table designer allows creating reports via simple Drag and Drop option in the visual designer; however, an experienced user can built reports manually by writing MDX queries. These two opposite approaches (from easy to technically demanding) provide the synergetic effect from cooperation between the users of different groups described above.

4.1.2. Pivot table designer UI

This section describes the pivot table designer UI and the use cases typical for the process of multidimensional data analysis based on the example of multi-page reports.

For the end user, Pivot table designer is a set of several areas or panels; some of those areas and panels can be hidden when opening the UI for the first time.

Pivot table designer includes five main areas used by the end user when creating Ad Hoc Reports for further analysis.



These areas are:

Area	Description
(1)	**Toolbar** is a panel with the command buttons used to create/design/built the pivot table and manage its layout and data
(2)	**Cube Browser** displays metadata and cube data that can be used when setting up the pivot table layout
(3)	**Selection Panel** shows the settings of the pivot table layout
(4)	**Active Filters** area shows the settings and description of filters applied to the data in the pivot table
(5)	**Pivot Table** area displays the result of processing the MDX query

Toolbar contains all frequently used commands for the end user. Commands are displayed as simple buttons, toggle buttons, and split buttons grouped according to their function. The commands not shown on the toolbar (in case there are any) can be reached by the user via the context menu of the corresponding visual item.

The detailed description of the commands can be found in the Toolbar section.

Cube Browser contains metadata and cube data in a tree-like form, which provides the user with highly productive and user-friendly visual interface. Metadata and cube data is used to form the pivot table during the report design or editing the MDX query.

The detailed description of the cube browser can be found in the Cube Browser section.

Selection Panel contains four areas that define the layout of the pivot table and the filter settings. Each of the areas is a container that stores icons in a particular order.

The detailed description of the Selection Panel can be found in the Pivot tables Designer section.

Active Filters area contains detailed settings (as hyperlinks) of filters applied to the pivot table data. The filters can be set up when designing the pivot table or sent as parameters during the table initialization. Left button mouse click on the hyperlink directs the user to the filter settings dialog window.

The detailed description of the Active Filter area can be found in the Active Filters section.

Pivot Table area displays the result of processing the MDX query in the form of a pivot table (by default) or as geographic maps, diagrams, and charts (in case such mode is initialized). The key feature of the pivot table is to provide interactive data analysis even for most complicated custom MDX queries.

The detailed description of the pivot table features can be found in the Pivot Table section.

4.2. TOOLBAR

Toolbar contains commands used to work with the pivot table designer and operate the data directly in the pivot table.

The tables below briefly describe the basic commands. It is also possible to launch some of the commands from the context menu of Selection Panel, Pivot Table, diagrams, and so on.

Pivot table designer commands

Icon	Command	Function
	Show/hide cube metadata	Displays or hides the area with the Cube Browser. If the button is activated the metadata area is displayed and vice versa.
	Execute MDX query automatically	Executes the MDX query automatically each time a user makes changes to the Selection Panel. If the button is activated any report layout modification results in data update.
	Execute MDX query	Executes the current MDX query on user's command.
	Calculations Custom Calculations Editor	Opens the Custom Calculations Editor dialog window. Is used to add Custom Calculations into the pivot table. Read more in the Custom Calculations section.
	Show/hide designer	Displays or hides the Designer panel
	Show/hide active filters	Displays or hides the Active Filters area of the report
	Show/hide MDX query	Displays of hides the MDX query area

	Designer mode	Switches the Pivot table designer modes between the Design and the Custom Query mode. The **Design mode** is the default one. In this mode, the MDX query is generated automatically based on the current settings of the Pivot table designer. The **Custom Query mode** uses custom MDX query that can be created manually and does not undergo any changes from the system's side. The button state informs that the Design mode is currently active. The button state informs that the Custom Query mode is currently active. Read more in the Pivot table designer modes section.
	Query import	Loads (imports) the report query from the server storage. The import restores the state of the Selection Panel, MDX query, and all other options (parameters) settings. The Tabs area of each report tab shows icons that display the state of the current MDX query. Dynamics of sales | Bicycle sales | Accessories sales Read more in the Reports storage section.
	Query export	Saves (exports) report settings into the Reports storage. The settings include Selection Panel settings, MDX query, and other options (parameters) settings. The report settings are stored on the server as XML files. Read more in the Reports storage section.
	Reset settings	Resets the Designer areas and report options (parameters) to default settings.
	Options Setting up Pivot table designer parameters	Opens the dialog window used to customize the options and parameters of the Pivot table designer. Read more in the Options and parameters section.
	What-If Analysis	A group of commands that allow the user to edit the cube data in the pivot table. This special initialization mode of the Pivot table designer is accessed according to the settings made by the system administrator. Read more in the What-If Analysis section.

Selection Panel commands

WPF/Silverlight

The table below shows the list of commands used to customize the pivot table layout in the Selection Panel. These commands allow the user to modify the order, places, and composition of the pivot table fields and data filters.

Right mouse click on a particular field opens the context menu with commands used to operate the structure through the Selection Panel.

Icon	Command	Function
	Filter	Opens the active filter settings dialog window. See more in the Data Filters section.
	Move up	Moves the Field to a higher level in the pivot table (one position up within the area).
	Move down	Moves the Field to a lower level in the pivot table (one position down within the area).
	Remove Field	Removes the Field from the pivot table (removes from the area)
	Change Filter	Opens the dialog window with filter settings. See more in the Data Filters section.
	Cancel Filter	Removes the filtering condition

Commands to customize the view of the Pivot table designer

HTML5

The list of pivot table fields can have different views, each of them optimized for particular tasks. To change the view, use the Tools button on the toolbar and choose the required view.

Icon	Command	Description
	Display fields and areas in a row	Default view. Intended to add and delete fields in case each area has more than four fields.
	Display fields and areas in a column	Intended to add and delete fields in case each area has one to four fields.
	Display only areas(2x2)	Intended to delete fields or change their place in the container.
	Display only areas(1x4)	Intended to delete fields or change their place in the container.

Pivot table commands

Icon	Commands	Description

	Update	Updates the pivot table data from the OLAP data source (sends another request to the data source).
	To Start	Moves to the beginning of the history of the pivot table queries.
	Move Back	Moves one step back in the history of the pivot table queries.
	Move Forward	Moves one step forward in the history of the pivot table queries.
	To End	Moves to the last position in the history of the pivot table queries.
	Clear Query Transformation	Restores the pivot table to its state upon initialization. Each command related to data analysis (Expand, Collapse, Detail, etc., including sorting modifications) changes the initial MDX query initializing the pivot table. Clearing query transformation in one step returns the pivot table to its initial state. The fact of using this command is saved in the history. Read more in the Clear Query Transformation section.
	Rotate Axes	Rotates all members in the rows and columns areas of the pivot table. All conditions used to filter the MDX query remain intact. The command is not active if any of the Rows and Columns areas has no cells.
	Hide Empty Rows	Displays/hides empty rows in the pivot table.
	Hide Empty Columns	Displays/hides empty columns in the pivot table.
	Copy	Copies the selected part of data inside a particular pivot table area into the clipboard.
	Paste	Pastes the content from the clipboard into the pivot table cells area. The data is pasted to the right and down the focused cell. The option is available only in the pivot table edit mode.
	Go to Focused Cell	Makes the focused cell visible in the pivot table. Is useful in case the focused cell is out of the visible part of the pivot table.
	Normalize size	Turns on the mode that automatically normalizes the height of the pivot table rows. When this button is activated, the height of all rows in the pivot table is changed automatically when the height of the current row is changed.
	Restore Default Size	Restores default size of all cells of the pivot table, both in the rows and the columns areas.
	Show/hide header	Displays or hides the header of the pivot table. In case this button is active, the header is visible.

	Show/hide footer	Displays or hides the footer of the pivot table. In case this button is active, the footer is visible.
	Hide popup hints and tips	Controls the display of the popup hints and tips for the cells, rows, and columns of the pivot table.
100	Scale	Adjusts the scale of the pivot table view. The pivot table becomes bigger or smaller compared to its default size. This parameter is shown as a percentage to the default size.
	Custom Styles Editor	Opens the dialog window to set up custom pivot table cell styles.. Read more in the Custom Styles Editor section.
	Settings of Pivot Table Properties	Opens the dialog window to set up pivot table parameters and characteristics.
	Data Export	This group of commands is used to export data from the pivot table to Microsoft Excel or XML format that can be read by Excel. The button exports the pivot table data into the **.xlsx* file. The export happens on the server where the MDX query is sent and executed. The result is returned as a Microsoft Excel file. The button exports the pivot table data into the **.xml* file. The exports happens on the client side and is processed much faster due to the fact the MDX query is executed only once.

4.3. PIVOT TABLE DESIGNER MODES

Pivot table designer can be used by different user groups. Some of them are entry-level users with no technical background, others are expert analysts able to write complicated and effective MDX queries manually.

Pivot table designer supports two different modes to provide all users with the most effective way to perform the analysis:

1. The **Design mode** is the default one. In this mode, the MDX query is generated automatically based on the settings in the Selection Panel.
2. The **Custom Query mode** uses a custom MDX query that can be created manually by the user and is not changed by the system in any way.

The Pivot table designer modes define the rules of receiving the MDX query by the OLAP data source. The button used to control the modes has two states:

Icon	Mode	Description
	Design Mode	Shows that automatic generation of the MDX query based on the Selection Panel areas settings is active.
	Custom Query Mode	Shows that Custom Query mode is active. The Selection Panel is inactive in this mode.

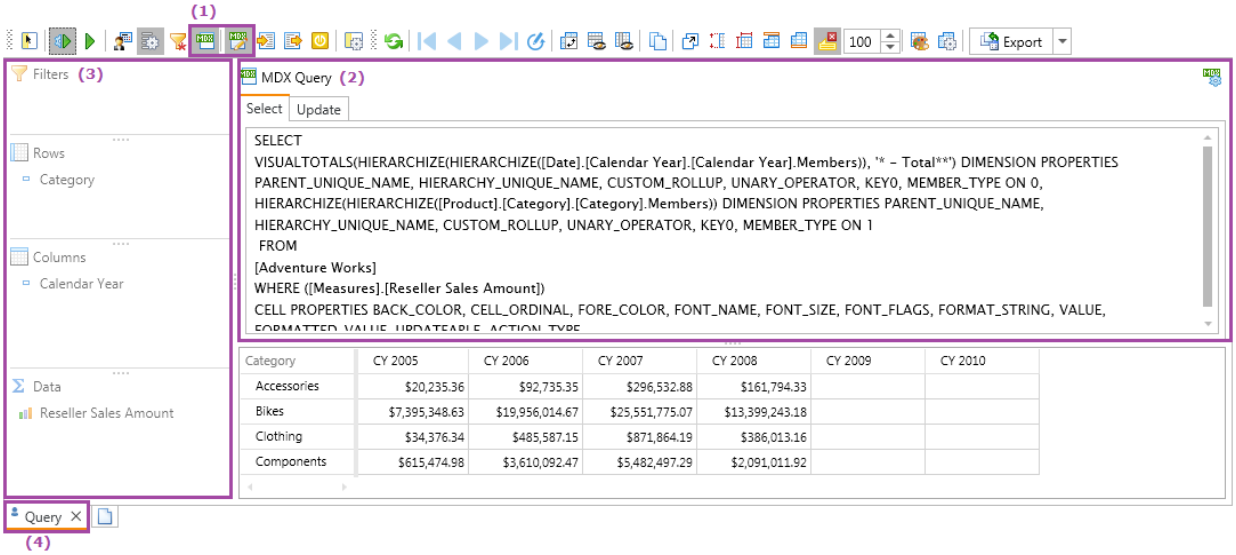
		The MDX query is expected to be written by the user (developer, cube administrator, analyst) or copied from another application. This mode allows using all functions of the MDX language in order to build the most effective solution for the report creation.

Each left button mouse click on the **Design Mode** button changes its current state to the opposite one. If the current state is **Custom Query Mode**, the user is warned that the manual changes to the MDX query will be lost. If the user accepts this, the MDX query is automatically updated according to the Selection Panel settings, and the Selection Panel itself becomes available for editing.

Note:

If the query was manually created or modified by the user, the icon appears in the report's Tabs Panel or in the header of the MDX query area.

A simple example below illustrates Pivot table designer interface in the Custom MDX Query mode.



Areas description:

Area	Description
(1)	It is a group of commands responsible for displaying the MDX query area and defining the mode of the Pivot table designer. The first button controls view of the MDX query area; the second one defines the Designer mode.
(2)	The MDX query area lets the user see and edit the text of the MDX query. The **Generate MDX** button allows the user to automatically create the MDX query based on the settings in the Selection Panel.

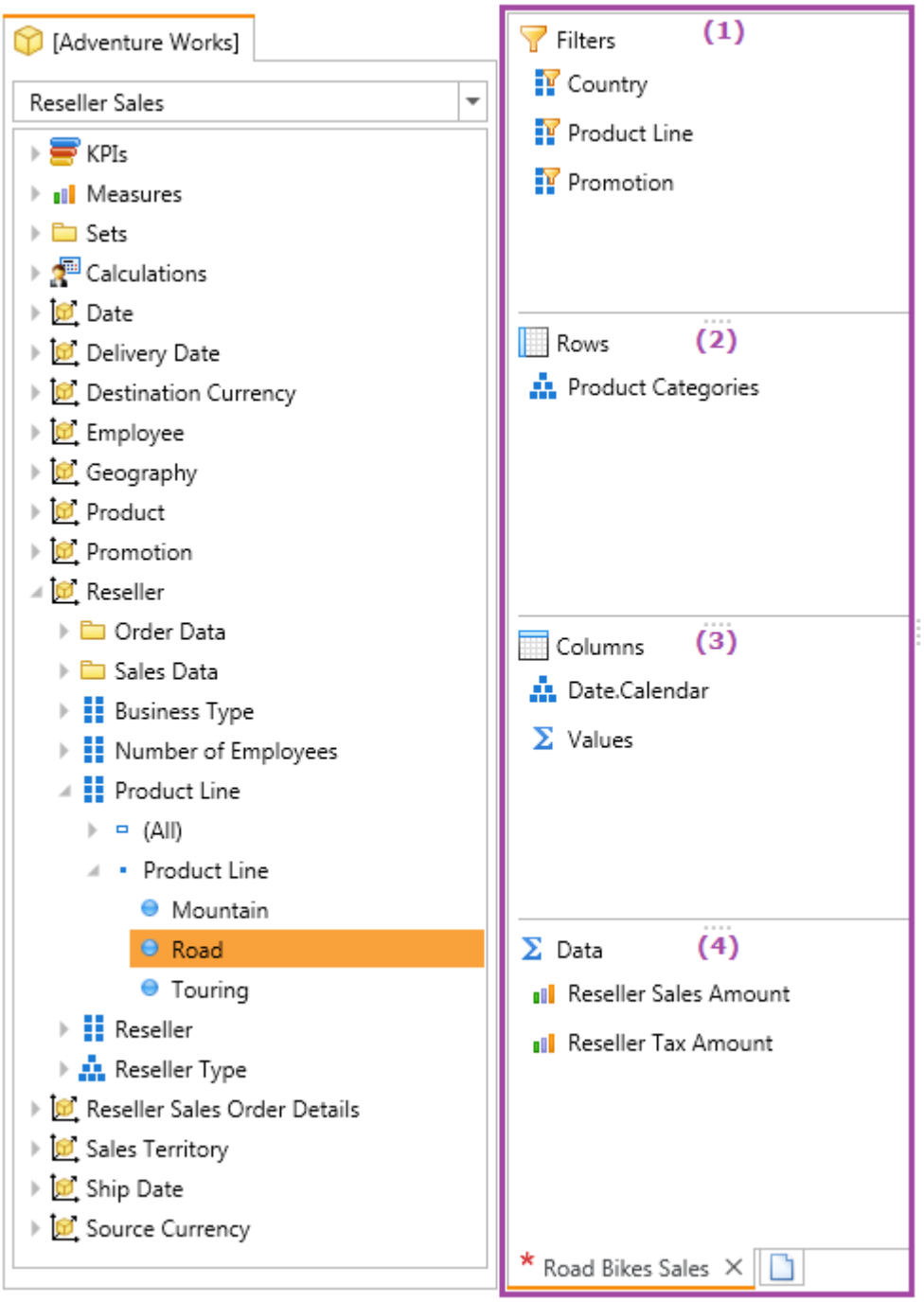
(3)	The Selection Panel shows the settings of the pivot table layout. It cannot be edited by the user in the **Custom Query Mode.**
(4)	The report's Tabs panel. The Tab has a special icon showing that the pivot table is built based on a custom MDX query.

4.4. DESIGNING A PIVOT TABLE

When creating a pivot table, the user should be able to see the list of fields provided by the data source, add the fieldsto the pivot table, customize their order and place, set up data filers, remove unnecessary fields, etc. The fields for the report are provided by the Cube Browser. The Selection Panel allows modifying the layout and styles of the pivot table view.

The Selection Panel contains several areas allowing users to add and remove various hierarchies, dimensions, measures, members, custom calculations, named sets, and so on, from the metadata cube entities to modify the layout of the pivot table. Based on the settings in the Selection Panel, the system automatically generates the MDX query to the OLAP data source. This MDX query is then executed, and the returned data is displayed in the pivot table or in another visual element (diagram, chart, or map).

This paragraph describes the Selection Panel in details. The Panel consists of the Cube Browser and four areas that define the layout of the pivot table and active data filters.



The Cube Browser displays the metadata and the cube's data tree. There is a separate Calculations node that displays only Custom Calculations. The Entities from the Cube Browser are used by the users to design the pivot table.

> ***Note:***
>
> *In terms of Microsoft Excel, the Cube Browser and the Selection Panel areas are equal to the PivotTable Field List.*

4.4.1. Four field list areas

Area	Icon	Description

(1)		This area displays the field structure and settings of the pivot table Filters area.
(2)		This area displays the field structure of the pivot table Rows area.
(3)		This area displays the field structure of the pivot table Columns area.
(4)	Σ	This area displays the field structure of the pivot table Data area.

Each area is an interactive container where users can add entities from the Cube Browser. The height and the width of each area can be modified using splitter that can be dragged with a mouse.

Each added entity is represented as a field icon (an iconthat shows the type of the entity). The name of the field icon is generated automatically based on the entity's title. The entities added to the Rows, Column, and Data areas define the layout of the report.

The field icon can be used to open dialog windows that allow customizing the rules of processing the members of this entity and to define the order of the fields in the report.

Right button mouse click on the field icon invokes the context menu with commands for modifying the fields in the Selection Panel container area. The detailed description of the commands can be found in the Modifying the fields list section.

Simple Drag and Drop is used to move the entities from the Cube Browser to the needed areas in order to define the pivot table layout.

Filters are field icons that represent dimensions, hierarchies, and levels. Users can setup the filtering conditions applied to the cube via manual selection of the needed members in the dimension hierarchy. The filter settings limit the cube data slice for analysis. Read more on how to setup filters in the Filters section.

Rows are icons that represent dimensions/hierarchies/levels used to define the layout of the report fields in the rows area (right side section) of the pivot table. Users can reorder the icons in the container, placing them up or down and, therefore, changing the order of these fields in the pivot table. It is possible to delete items or add new entities from the Cube Browser. Users can set filters manually by picking members in the dimension hierarchy or use program filters. The filters limit the cube data for further analysis.

Columns are icons that represent dimensions/hierarchies/levels used to define the layout of the report fields in the columns area (top section) of the pivot table. Users can perform the same actions as in the rows area setup.

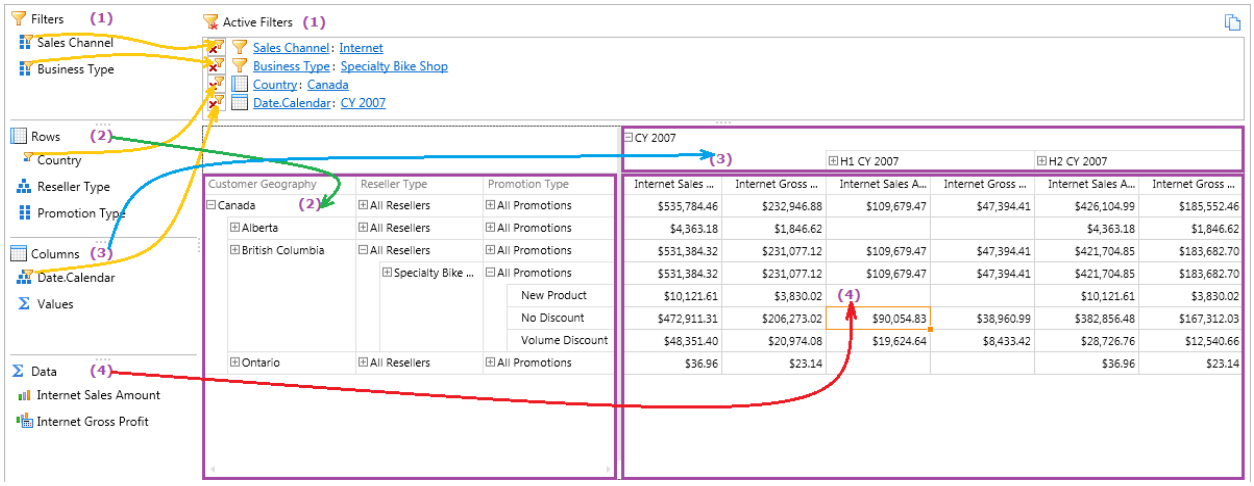
Data contains the icons that represent values. They include members from the measures dimension, KPIs, and custom calculated members. In case there are two or more values in the area, it is possible to display them either in the rows (right side section) or the columns area (top section) in the pivot table. The area is defined by a special Values icon that is created automatically. Users can drag the Values icon from the rows area to the columns one or vice versa.

The image below illustrates the connection between the OLAP data source, the Cube Browser, the Selection Panel areas, and the pivot table that displays the result of the MDX query execution.

The pivot table contains the following areas:

Area	Description
(1)	The Active Filters area shows the filtering conditions applied to the pivot table data in the Pivot table designer. Active Filters show settings for Filters, Rows, and Columns.
(2)	The Rows area shows the rows of the pivot table. The pivot table contains rows as defined by the order in which the fields of the Selection Panel rows area are situated. Each field of the rows area is displayed in the pivot table as a separate column.
(3)	The Columns area shows the columns of the pivot table. The pivot table contains columns as defined by the order in which the fields of the Selection Panel columns area are situated. Each field of the columns area is displayed in the pivot table as a separate row.
(4)	The Data area shows the values of the pivot table cells. The data is displayed in the cells area of the pivot table.

The layout of the pivot table is the information about the rows, columns, and data of the pivot table. The picture below shows a typical example illustrating how the Selection Panel fields are displayed in Active Filters and in the pivot table.



https://support.office.com/en-us/article/Use-the-Field-List-to-arrange-fields-in-a-PivotTable-43980e05-a585-4fcd-bd91-80160adfebec?ui=en-US&rs=en-US&ad=US

When adding new areas to the Selection Panel rows area, the size of the pivot table rows area increases automatically taking the space from the columns area. If there is not enough space in the rows area of the pivot table to display all fields defined in the Selection Panel rows area, the user can enlarge the pivot table rows area by using a splitter or by just scrolling to find the needed row.

The height and the width of the areas can be modified by dragging the splitter with a mouse.

Note:

The columns area of the pivot table cannot be completely hidden; at least one column is always visible.

4.4.2. Field list

To add a field info the field list, simply drag the desired entity from the Cube Browser to the needed area.

1. Dimensions (with the exception of a special **[Measures]** dimension), their hierarchies, and hierarchic levels can be placed into the following areas: filters **(1)**, rows **(2)**, and columns **(3)**;
2. Named sets (including custom ones) can be added only in the rows **(2)** or columns **(3)** areas;
3. The members of the [Measures] dimension, KPIs, and custom calculated members can be dragged only to the Data **(4)** area.

Important:

The same hierarchy cannot be added to Rows and Columns areas simultaneously.

For instance, if the [Product Categories] hierarchy is used in the Columns **(3)** area, it is not possible to useit in the Rows **(2)** area. If the user drags it to the Rows area **(3)** the hierarchy will be automatically removed from the Columns area **(3)** and added to the Rows area **(2)**.

To move a field from one pivot table area to another, drag the icon with the field's name to the desired area.

If the field is moved beyond the area that contains the field list, it is removed from the settings of the pivot table layout (it is equivalent to using the **Remove Field** command).

To change the position of the field in the pivot table, open the context menu by a right button mouse click on the icon with the field's name and use the **Move Up** or **Move Down** command. These commands move the selected field one position up or down within the container.

To set up a data filter, open the context menu by a right button mouse click on the icon with the field's name and select **Filter** or **Change Filter**. It will open a dialog window in which the list of elements that should be added into the report can be defined. Read more on using filters in the Filters section.

To remove a filter applied to the data, open the context menu by a right button mouse click on the icon with the field's name and select **Cancel Filter**.

The metadata entities used in setting up the pivot table fields are marked in the Cube Browser tree with a bold font.

Special member Values

When more than one measure is used in the Data area **(4)**, a special member called Values is added into the field list to combine the members' values as a virtual group. By default, the Values member is added to the Columns area **(3)**. To see the values of the Data area **(4)** members in the Rows area **(2)**, the user simply drags and drops the Values member into this area. If the user removes the members' values from the Data area **(4)**, the Values member will be automatically deleted as soon as this area contains less than two members.

Removing the Values member from the field list automatically deletes all members from the Data area **(4)**.

Other features

Custom calculated members can be created for any of the cube hierarchies. It means that a user-created calculated member that is not present in the [Measures] dimension can be added to the Data area **(4)**. Though it is a normal case, it should be checked that all elements added into the Data area **(4)** belong to the same hierarchy. Read more about using custom calculations in the Custom calculations section.

4.4.3. History of design and navigation

Pivot table designer saves the history of changing states and settings for the Selection Panel as well as the navigation on the pivot table data. It is a key feature of the pivot table designer that has a significant influence on the usability, making Ranet a perfect choice for any user.

The history saves all user actions related to modifying the Selection Panel fields and all commands that customize pivot table layout.

The Navigation buttons for using history and navigation options can be found in the toolbar  or accessed via the pivot table context menu.

Note:

This section is important for understanding the pivot table designer's capabilities and the options available to analyze data directly in the pivot table.

Ranet records each user action that:

1. Changes the Selection Panel fields settings:
    a. Adding new fields from the Cube Browser to Filters, Rows, Columns, and Data areas. If a particular cell is focused in the pivot table, then **(All)** level is automatically opened for the field that is being added;
    b. Changings the order of fields (dragging the field icon up or down in the container) in the Rows, Columns, and Data areas;
    c. Dragging fields from/to the Filters, Columns, and Rows areas;
    d. Setting up filters;
    e. Removing a field.
2. Leads to any data transformation in the pivot table:
    a. Expanding or minimizing a node via [+] and **[-]** buttons;
    b. Using one of the following commands: Drilldown, Drilldown with parent, Drilldown by…, etc.;
    c. Modifying data sorting in rows and columns;
    d. Rotating the axes of the table.

The actions can alter; it is possible to modify fields settings in the Selection Panel and data in the pivot table in any order. User navigation history saves the current pivot table data layout after each modification of Selection Panel field settings.

Removing a field from the Selection Panel leads to deleting the history related to this field.

Thus, the system remembers all user actions and can restore any previous data layout when either the Selection Panel or the pivot table settings are modified. No need to expand the nodes once again to get to the newly added dimension; everything is done automatically.

Using To Start ( ) command, the user gets empty Selection Panel settings. Using To End ( ) command, the user gets the latest state of the Selection Panel and the pivot table settings, and the navigation and design history is restored completely.

Clear transformation ( ) command restores the pivot table in its initial (immediately after the initialization) state. In this scenario, the history of the pivot table data navigation is saved.

Generate MDX ( ) command saves the current state of the Selection Panel settings while deleting the pivot table data navigation and transformation history. After the call of this command, the design and navigation history starts recording from scratch.

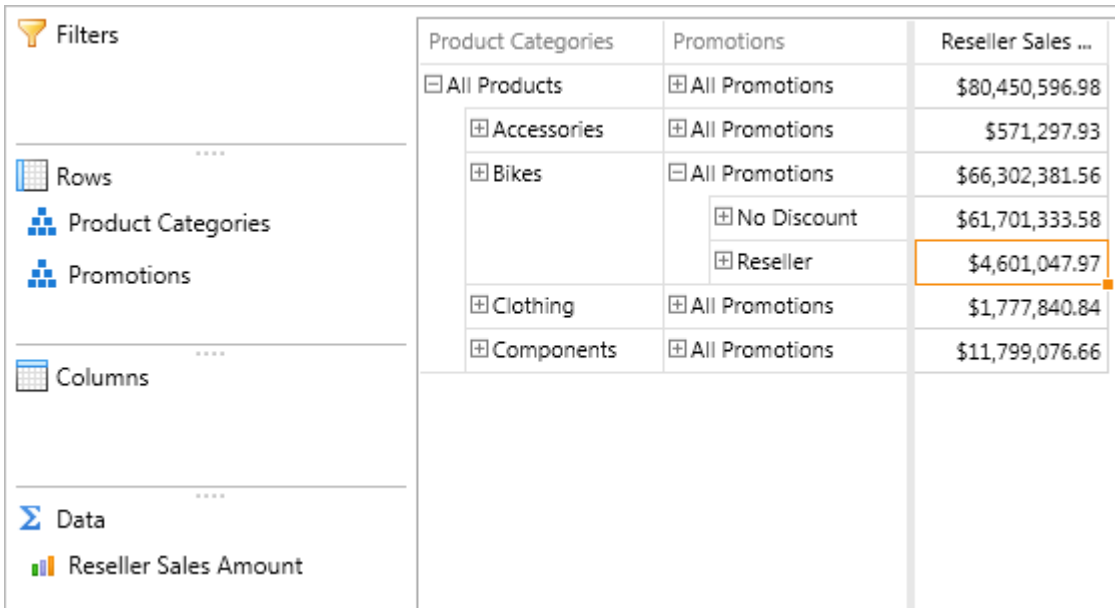
Reset ( ) button resets the pivot table designer to default settings and removes all fields from the Selection Panel.

Let's see an example.

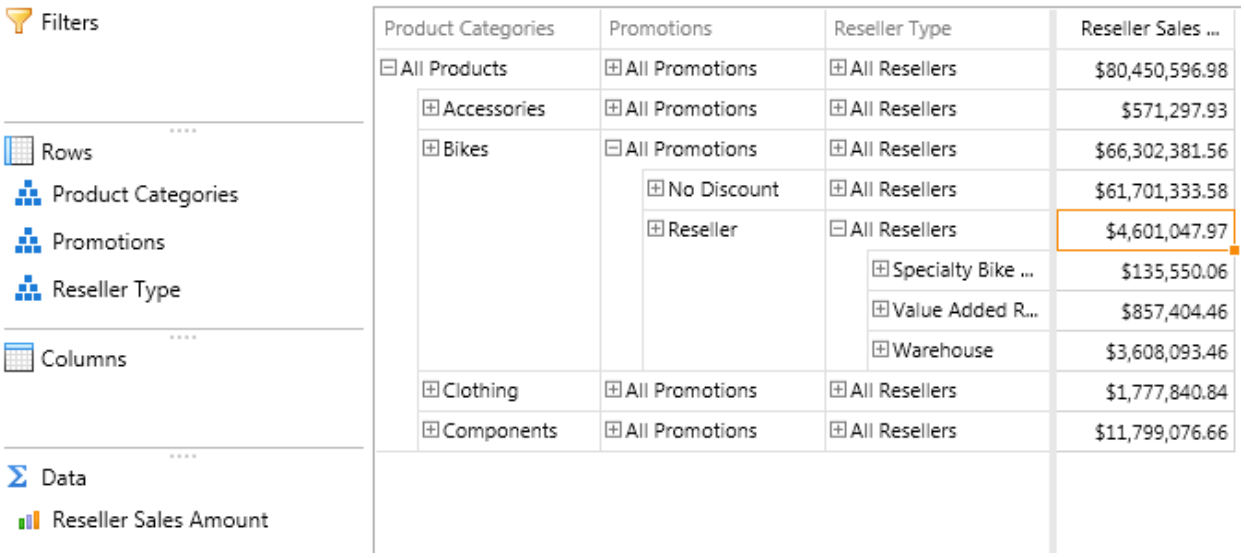
1. In the Cube Browser, set a filter on the [Reseller Sales] measure group, select the [Reseller Sales Amount] parameter for analysis, and drag it to the Data area;
2. In the [Product] dimension, choose the [Product Categories] hierarchy and drag it to the Rows area;
3. In the pivot table, expand the [All Products] node and focus the cell in the [Bikes] row.

Now, let's get down to detailed analysis of the [Bikes] sales.

4. In the [Promotions] dimension select the [Promotions] hierarchy and drag it to the Rows area. Now the [Bikes] data is detailed according to [Promotions] (the [All Promotions] node is opened automatically);



5. In the pivot table, focus the cell in the [Reseller] row to get detailed data;
6. In the [Reseller] dimension, select the [Reseller Type] hierarchy and drag it to the Rows area. Now the [Reseller] data is detailed according to [Reseller Type] (the [All Resellers] node is opened automatically).



Bottom line:

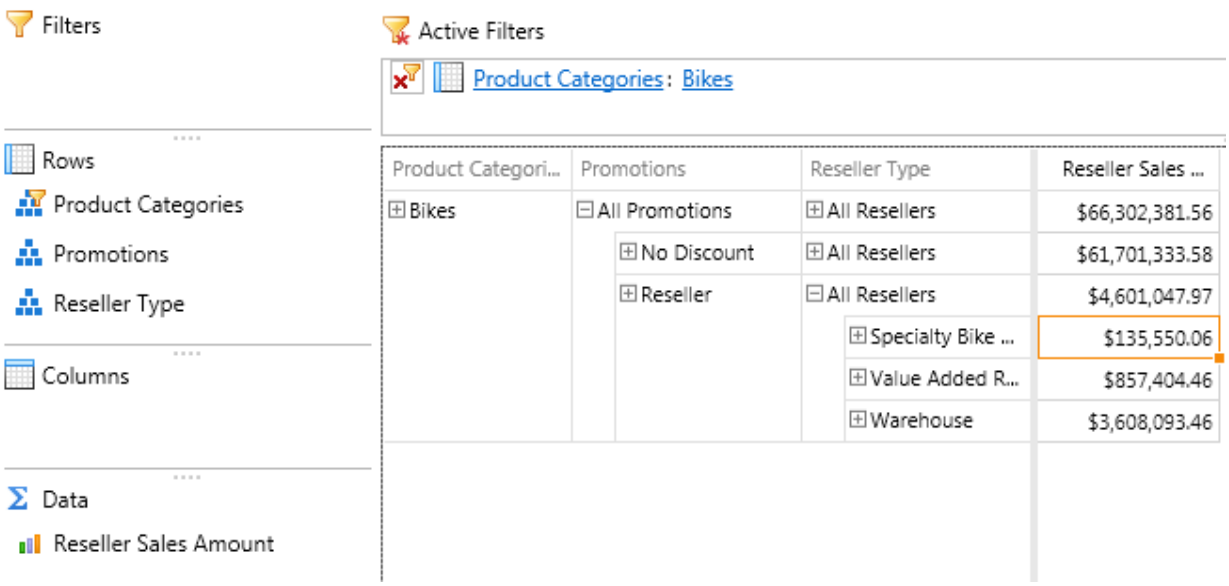
- When a new field (a dimension hierarchy) is added in the pivot table designer, the user actions history is saved (as seen, all required nodes in the pivot table are expanded, and the focus is the same). The user doesn't need to repeat the actions to get to the analyzed data; it improves usability and provides faster analysis.
- The user can go one step back or to the beginning and then back to the end of the pivot table design history.

Important:

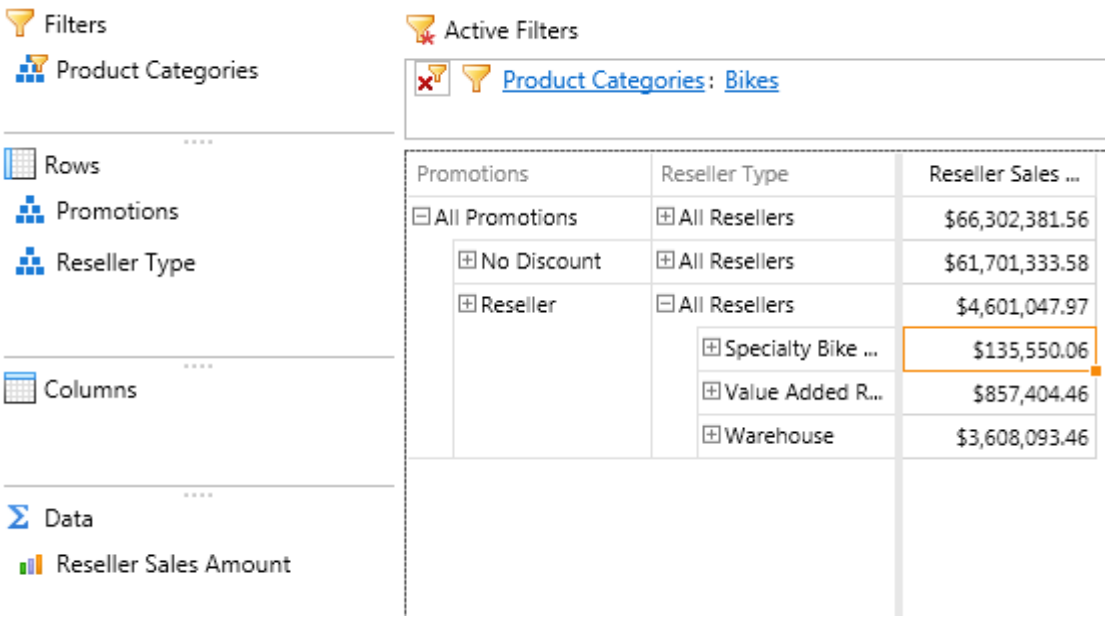
There should always be a focused cell in the pivot table whose coordinates determine the data slice for detailed analysis.

This example can also be used to explain data filtering based on the [Bikes] sales data analysis.

7. In the Rows area, invoke the context menu of the [Product Categories] field icon and open the filter settings dialog window. In the filter settings, pick the [Bikes] element. When the filter is applied, the pivot table changes as shown in the picture below. As seen, there is the [Bikes] filter in the Active Filters area, and the user actions history is saved;



8. This example is based on [Bikes] sales data analysis, the filter is set on this category with disregard for others. Let's set up a data slice on that category by dragging the [Product Categories] field from the Rows to the Filters area. As shown below, the [Product Categories] column disappeared from the Rows area of the pivot table, and the user actions history is saved.



Bottom line:

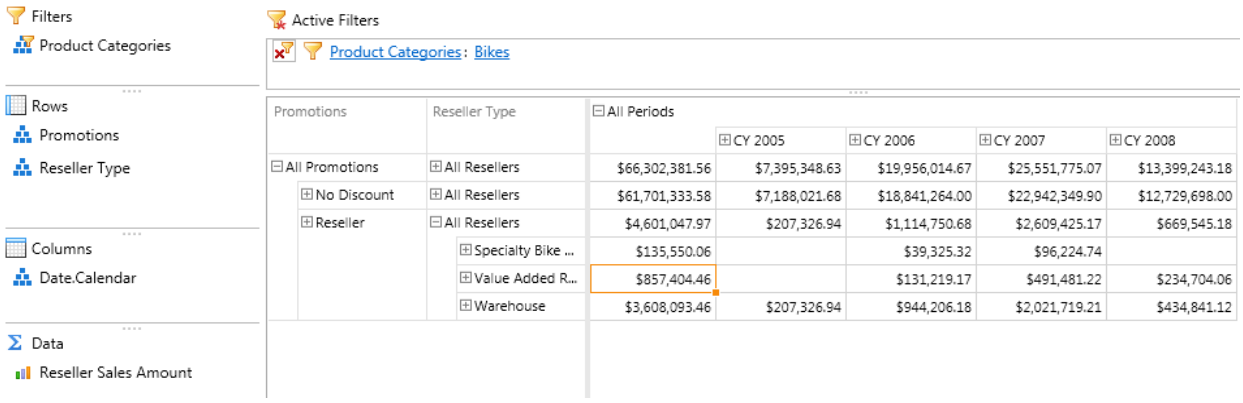
- When setting up filters for hierarchies whose data is currently detailed (the [Bikes] and [Reseller] elements in the example), the user actions history is saved.
- If the filter is used to slice the data (the example shows the [Product Categories] field dragged from the Rows to the Filters area), the user actions history is saved.

Important:

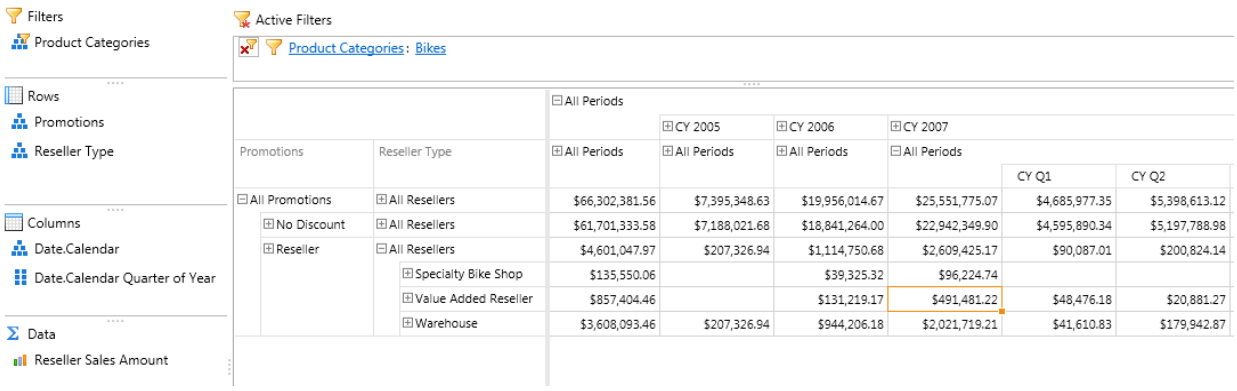
There should always be a focused cell in the pivot table whose coordinates determine the data slice for detailed analysis.

The example above shows how to work with the Rows area. Now let's examine the behavior of the pivot table when hierarchies with detailed data are added into the Columns area.

9. Focus the cell in the [Value Added Reseller] row.
10. In the [Date] dimension, select the [Date.Calendar] hierarchy from the [Calendar] folder and drag it to the Columns area. Now, the [Value Added Reseller] data is detailed by periods (the [All Periods] node is opened automatically).



11. Focus the cell in the [Value Added Reseller], [CY 2007] row.
12. In the [Date] dimension, open the [Calendar] folder, select the [Date.Calendar Quarter of Year] hierarchy, and drag it to the Columns area. Now, the [Value Added Reseller] and [CY 2007] data is detailed by quarter periods (the [All Periods] node is opened automatically).



13. Similarly to the filter settings for [Bikes] in the [Product Categories] hierarchy, set the filter on the [Date.Calendar] for [CY 2007]. The user actions history is saved.

4.4.4. Customizing pivot table designer settings

Pivot Table options

https://support.office.com/en-us/article/PivotTable-options-27c02eb7-27de-4b3f-9677-c48e3fe7637b?ui=en-US&rs=en-US&ad=US

To customize different pivot table designer settings, modify the properties' values described in the table below.

Property	Purpose
The maximum number of tuples to be returned	Specifies the maximum number of tuples in the set that is to be returned to the axes of the pivot table rows and columns. **The values should always be equal to zero.** Using this parameter is not recommended for unpredicted results. • The set of tuples is formed based on all members (including those members which values are equal to NULL); • Then the set of tuples is processed by the Subset function. There is a high possibility that only the empty (equal to NULL) members will end up in the set; • If the axis doesn't display empty members (using NON EMPTY), the set may be empty, so there is nothing to display along the axis.
Generate Custom Calculations for Level	Check or uncheck this box to use or not use custom calculated members in counting the expression result of the tuples' set for the level members.

	Depends on the maximum number of tuples to be returned. For zero quantity of tuples, no calculations are created.
Use Visual Totals for Hierarchy	Check or uncheck this box to use or not use the dynamic sum result counting for child members in the set for a hierarchy. Visual totals cannot be created if: • There is more than one hierarchy in the area settings; • The elements' order in the set breaks the hierarchy; Visual totals do not count child calculated members when calculating the sum result. This parameter defines if the VISUALTOTALS function is used for the set while generating the MDX query.
Hide items with no data in the rows	Check or uncheck this box to show/hide empty items in the rows of the pivot table. The item is empty in case all cells values of its rows are empty (equals NULL, NULL stands for no value). This property defines if the NON EMPTY key word is used for the Rows area when generating the MDX query.
Hide items with no data in the columns	Check or uncheck this box to show/hide empty items in the columns of the pivot table. The item is empty in case all cells values of its columns are empty (equals NULL, NULL stands for no value). This property defines if the NON EMPTY key word is used for the Columns area when generating the MDX query.
Include all calculated members in the hierarchy or level	Check or uncheck this box to include/exclude all calculated members of the hierarchy or level into the set. The property specifies which function is used to get a set when generating the MDX query: • AllMembers – includes calculated members; • Members – excludes calculated members.
Include calculated members in drilldown results	Check or uncheck this box to include/exclude calculated child members into drilldown results. This property defines if the INCLUDE_CALC_MEMBERS key word should be used in the DrillDownMember function when generating the MDX query.
Load the saved state from history	Check this box to save the history of the pivot table modifications when the report template is saved in the pivot table designer.

	This option provides the opportunity to restore the earlier state of the report template when reusing the template.

Using Visual Totals for Hierarchies

It is time to demonstrate the Use Visual Totals for Hierarchy setting and how it influences the layout. For example, you need to get the volume of sales of a particular dealer in the [Accessories] and [Bikes] categories of goods. Let's design a pivot table:

1. Select the [Reseller Sales Amount] measure from the [Reseller Sales] measure group;
2. Drag the [Product Categories] hierarchy from the [Product] dimension and drop it to the Rows area. Then set up the filter by choosing [Accessories] and [Bikes]. Read more on using filters in the Filters section.

Now the pivot table displays these two items without their totals. To get those total, add the [All Products] item into the current filter.

Important:

To form visual totals, always pick the parent item that is one level higher.

The image below shows the results for both cases (when visual totals are disabled and enabled). The table in the right displays the totals based on filter settings, and the item that forms visual totals has [**-Total***] in its header.

Use Visual Totals for Hierarchy

is disabled

Product Categories	Reseller Sales Amount
⊟ All Products	$80,450,596.98
⊞ Accessories	$571,297.93
⊞ Bikes	$66,302,381.56

is enabled

Product Categories	Reseller Sales Amount
⊟ All Products - Total*	$66,873,679.48
⊞ Accessories	$571,297.93
⊞ Bikes	$66,302,381.56

This example can be more complex:

3. Drag the [Date.Calendar] hierarchy from the [Date] dimension [Calendar] folder and drop it to the Columns area. Then apply the filter based on years by choosing [CY 2006] and [CY 2007]. To get visual totals, add the [All Periods] items to the filter.
4. For the [Accessories] category, pick the [Cleaners] and [Helmets] subcategories; for the [Bikes] category, pick the [Mountain Bikes] and [Touring Bikes] subcategories.

The left table contains marked items that are added to the filter. The pivot table in the right displays the visual totals for hierarchies in rows and columns. They are also available for the lower levels in the product hierarchy.

Product Categories	All Periods		
		CY 2006	CY 2007
All Products	$80,450,596.98	$24,144,429.65	$32,202,669.43
Accessories	$571,297.93	$92,735.35	$296,532.88
Bike Racks	$197,736.16		$118,428.47
Bottles and Cages	$7,476.60		$4,481.33
Cleaners	$11,188.37		$6,733.09
Helmets	$258,712.93	$74,281.39	$113,443.66
Hydration Packs	$65,518.75		$41,531.96
Locks	$16,225.22	$10,084.70	$6,140.52
Pumps	$13,514.69	$8,369.26	$5,145.43
Tires and Tubes	$925.21		$628.42
Bikes	$66,302,381.56	$19,956,014.67	$25,551,775.07
Mountain Bikes	$26,492,684.38	$9,190,838.09	$8,854,263.03
Road Bikes	$29,358,206.96	$10,765,176.58	$11,294,381.37
Touring Bikes	$10,451,490.22		$5,403,130.67

Use Visual Totals for Hierarchy

Product Categories	All Periods - Total*		
		CY 2006	CY 2007
All Products - Total*	$23,642,689.94	$9,265,119.49	$14,377,570.45
Accessories - Total*	$194,458.14	$74,281.39	$120,176.75
Cleaners	$6,733.09		$6,733.09
Helmets	$187,725.05	$74,281.39	$113,443.66
Bikes - Total*	$23,448,231.80	$9,190,838.09	$14,257,393.71
Mountain Bikes	$18,045,101.13	$9,190,838.09	$8,854,263.03
Touring Bikes	$5,403,130.67		$5,403,130.67

Now let's see the case when the Rows area contains two hierarchies. Drag and drop the [Date.Calendar] field icon from the Columns area to the Rows area. There are two fields, ([Product Categories] and [Date.Calendar]), in the Rows area. Despite the visual totals mode being enabled, no totals are displayed.

Important:

Visual totals are counted only in case ***one hierarchy*** *(one field) is selected in the Rows or the Columns area.*

If the [Product Categories] field icon is dragged back to the Columns area, the visual totals is formed (the Rows and Columns areas will have one hierarchy).

Calculated members and Drilldown

Calculated child members may be created in any place of the hierarchy. They can contain all kinds of intermediate calculations that the user needs to perform the data analysis. The number of such calculations is unlimited.

In the example above, create a calculated child member for the [Bikes] category containing the [Mountain Bikes] and [Touring Bikes] subcategories. Read more on how to create a custom calculation in the Custom calculations section.

Name	Expression
[Product].[Product Categories].[Category].&[1].[Mountain+Touring]	[Product].[Product Categories].[Subcategory].&[1] + [Product].[Product Categories].[Subcategory].&[3]

Use the **Include calculated members in drilldown results** option to include calculated child members for the current item when it is detailed (via **Drilldown**, **Expand**, etc.) in the pivot table.

The image below shows how this option enables the display of a calculated child member [Mountain+Touring] for the [Bikes] parent in the right pivot table.

Include calculated members in drilldown results

is disabled

Product Categories	Reseller Sales Amount
⊟ All Products	$56,347,099.08
⊞ Accessories	$389,268.23
⊟ Bikes	$45,507,789.75
⊞ Mountain Bikes	$18,045,101.13
⊞ Road Bikes	$22,059,557.95
⊞ Touring Bikes	$5,403,130.67
⊞ Clothing	$1,357,451.34
⊞ Components	$9,092,589.76

is enabled

Product Categories	Reseller Sales Amount
⊟ All Products	$56,347,099.08
⊞ Accessories	$389,268.23
⊟ Bikes	$45,507,789.75
⊞ Mountain Bikes	$18,045,101.13
⊞ Road Bikes	$22,059,557.95
⊞ Touring Bikes	$5,403,130.67
Mountain+Touring	$23,448,231.80
⊞ Clothing	$1,357,451.34
⊞ Components	$9,092,589.76

Important:

If the drilldown command is not used in the report, then create a custom named set, add there the calculated member explicitly, and use this set to define the cell structure of the pivot table.

4.5. ACTIVE FILTERS

The active filters area (under number **(4)** in the Pivot Table Designer UI) displays all filters applied to the data in the report. Each filter setting has a title based on the description of either the chosen item or the program filter settings (such as **Top N**, etc.). It allows the user to see all active filters applied to the data in the pivot table and change them quickly if required. Read more on how to use filters in the Filters section.

Active filters and their titles are exported into Microsoft Excel or XML when the pivot table data is exported.

4.6. EXTRA AREAS

The pivot table designer has several extra areas to display and edit some data that can be required by the user when performing data analysis.

Area	Description
()	MDX query is an area displaying the MDX query. It defines the algorithm for receiving data for the report.
()	Header is the area displaying the report's header.
()	Footer is the area that displays the report's footer.

The areas are shown/hidden according to the state of the corresponding toggle buttons that can be activated from the main window toolbar.

4.6.1. MDX Query

The MDX query area is used to display the MDX query of the pivot table designer. Depending on the pivot table designer mode, the MDX query can be generated automatically based on the report structure settings in the reports designer or edited manually by the user. The current state of the MDX query is indicated by special icons described in the table below. More info in Pivot tables designer modes.

When analyzing data, the MDX query from the pivot table designer is sent as a parameter used to initialize the whole pivot table. In the pivot table, the MDX query is parsed and modified when needed. For instance, the history of the user commands can be used to restore the latest saved state of the pivot table; or the settings of the **Hide empty Rows/Columns** can be modified.

4.6.2. Header/Footer

The **Header** area displays the report's header for the pivot table; the **Footer** area shows its footer.

Header is a text area used to display comments (or other data related to the pivot table structure and other data being shown in the report) in the header. The field can be modified by the user; it is also exported to Microsoft Excel prior to the pivot table data.

Footer is a text area used to display a footer with extra information related to the pivot table settings or the data being shown in the report. It is processed similarly to the Header field and is exported to Microsoft Excel right after the pivot table data.

4.7. MULTIPAGE REPORTS (BOOKS/PACKAGES OR REPORTS)

In the pivot table designer, multipage reports (books/packages or reports) can be created. In such case, a separate report is created in the pivot table designer on each page of the book.

Each separate report has its own unique set of parameters, Selection Panel areas settings, custom calculation settings, custom cell styles, etc.

Note:

In terms of Microsoft Excel, a multipage report is a books of reports where each report is based on the pivot table and is shown on a separate page.

4.7.1. Working with a book of reports

A multipage report (Book/Package of reports) always contains at least one sheet. These sheets can be added, renamed, deleted, and so on. The name of the sheet that contains the report (hereinafter report Name) is displayed on its icon in the reports tab panel. The default name for the sheet is Query; it can be changed to any other name.

Basic pivot table designer commands used to work with multipage reports are described in the table below. The commands are called via the context menu through a right button mouse click on the tab in the reports tab panel.

Icon	Command	Description
	Add new	Creates a new tab (adds a new report to the book).
	Delete	Deletes the current tab (removes the selected report from the book).
	Rename	Renames the tab's icon and changes the report name.
	Create a copy	Creates a copy of the report in the selected tab (adds a new report into the book and copies the original settings into it).

Adding a new report (new sheet)

To add a new report (add a new sheet into the book), perform one of the following actions:

1. In the reports tab panel, click the button (purple highlight)

2. In the report tab panel, right button mouse click the current tab and select the **Add new** command.

Deleting a report (sheet)

To delete a report from the reports tab panel, right button mouse click the tab that should be deleted and choose the **Delete** command. A single sheet cannot be deleted.

Renaming a report (sheet)

1. In the report tab panel, right button mouse click the tab that should be renamed and choose the **Rename** command.
2. Highlight the current name and change it.
3. Use the Enter keyboard button to save the changes. The name is not checked to be unique.

Copying a report

Copying a report means creating a copy of the report in a new tab (sheet).

To copy the report, right button mouse click the tab with the report to be copied in the report tab panel and use the **Create a copy** command.

The result of performing this command is the creation of a new tab (new report sheet) that copies all settings of the pivot table designer of the original report (the current tab). The name of the new report is formed automatically based on the original report's name but with an added index. The tab of a newly created report immediately becomes current in the tab panel. The copy looks absolutely the same as the original report.

Besides commands used to manipulate the sheets in a Book of reports, the pivot table designer toolbar provides commands allowing to manipulate the whole Book of reports.

Icon	Command	Description
	Reset all settings to their initial state	Deletes all sheets with reports from the Book of reports (except one). The remaining sheet has its pivot table designer options restored to the default state.
	Import query layout settings	Loads (imports) the whole Book of reports. The required number of tabs for all reports (sheets) with report settings is created in the Book. If the report settings are different from the default ones, special icons are displayed on their tabs in the reports tab panel. * Dynamics of sales X | Bicycle sales X | Accessories sales X
	Export query layout settings	Saves (exports) the whole Book of reports. Exporting layout settings uses the server to save (export) the settings of the pivot table designer, the MDX query, and other settings. The settings are saved on the server as XML files.

Read more on how to use the storage of reports in the Reports storage Section.

The table below describes possible states of the pivot table designer.

Icon	Meaning
	Shows that the report is loaded in the same state as the pivot table had when saving the report to the storage. The current MDX query from the pivot table or the history of user commands related to changing data in the pivot table is saved.
	Shows that the report is formed based on a user-modified MDX query. It is built in the **Custom Query mode**.
*	Shows that the user modified the structure of the pivot table layout via the Selection Panel.

4.7.2. Working with a report (sheet)

The table below demonstrates basic pivot table designer commands for working with multipage reports.

Right button mouse click on the tab icon in the report tab panel opens the context menu with commands to modifying this report (sheet).

Icon	Command	Description
	Reset query layout settings	Removes all report settings and restores the default state of all options and parameters of the pivot table designer.

	Generate MDX	Generates the MDX query based on the pivot table designer settings. The history of design and navigation is cleared in this case.
	Import layout	Imports the layout of the report from the server. When importing the report, all fields of the Selection Panel, custom calculations and styles, the MDX query, and other options and parameters are loaded. The report's (tab's) title is automatically changed to match the name of the layout. If the report settings state differs from the default one, then an icon is displayed on the report's tab to inform the user about it.
	Export layout	Saves the current report to the server. Includes the Selection Panel fields settings, custom calculations and styles, the MDX query, and the history of design and navigation. All settings are saved to the server as XML files.

Read more data on how to use the reports storagein the Reports storage section.

Exporting the report

The report layout can be saved to the file storage on the server. It allows using them later to analyze OLAP data or create new reports. To export the report:

1. In the reports tab panel, open the context menu by a right button mouse click on the required report's tab and select the **Export layout** command.
2. In the opened dialog window **Save As**, specify the unique name of the layout, the folder, and the description.
3. To save the report, click OK.
4. When exporting the layout, the name is checked for being unique, so, in case the report with the same name is found, a special dialog window informs the user that the title of the report should be changed.

Importing the report

To import the report layout from the server file storage:

1. In the reports tab panel, right button mouse click the tab of the report to be imported from the storage and use the **Import layout** command in the context menu.
2. In the opened **Load From** dialog window, select the unique name of the needed report.
3. Click OK to load the layout.

When the layout is imported, all previous report settings in the current tab are replaced with the new ones. The report title in the selected tab is automatically changed to match the name of the layout. If the navigation history was saved while exporting the layout, it is loaded back, and the user sees the pivot table in the same state it was in when exported. Possible states of the report were described in the table above.

5. PIVOT TABLE DATA FILTERING

5.1. OVERVIEW

The user gets a quick, easy, and convenient way to find and use a data subset in the pivot table. Only the rows and columns specified by the user and/or satisfying the defined criteria are displayed in the pivot table.

The Member Choice window allows selecting the items displayed in the pivot table and using filters. It can be found in the context menu of the field icon in the Selection Panel or via clicking the field hyperlink in the Active filters area.

When a filter is applied to a field, the icon is displayed near its icon in the Selection Panel.

Filters can be used to select a set of data for display without manipulating the fields structure in the Selection Panel.

There are two types of filters supported in the Pivot table designer:

1. **Member choice filter** is a simple filter that requires the user to select the desired members manually from a particular dimension.
2. **Condition filter** is an advanced filter that forms the set of data automatically on the basis of logical operations, aggregating functions, and various conditions applied to custom characteristics of the dimensions' member, etc.

Advice:

Use filters whenever possible. They are used to generate a server-processed MDX query to the data source to provide the customer with the data that satisfy the filtering criteria.

Filter settings for all areas (Filters, Columns, Rows) are displayed in the Active filters area. Their descriptions are user-friendly. Read more in Active filters.

Filter settings are used to define the cube's data slice being analyzed in the pivot table. They form a Subcube for further MDX query generation.

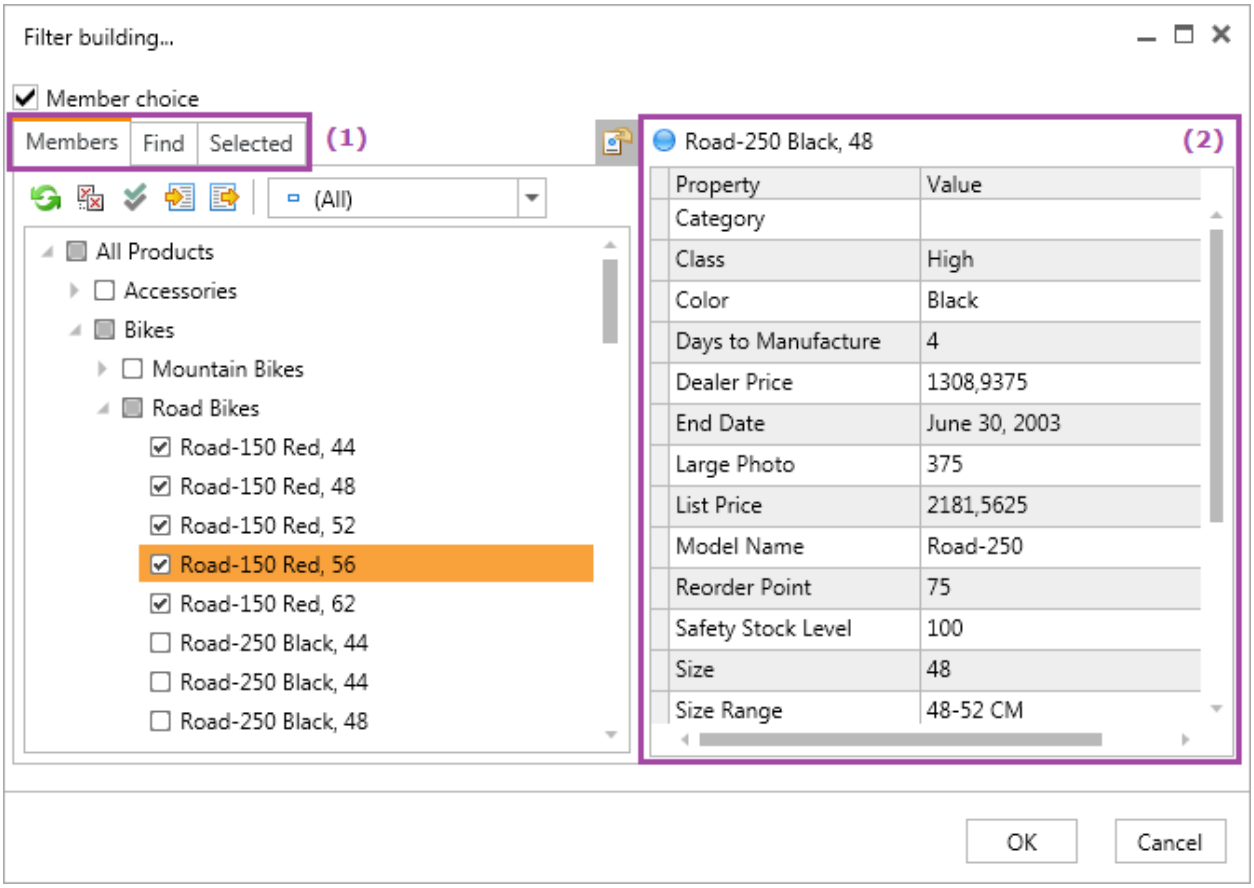
5.2. MEMBER CHOICE CONTROL

Member Choice Control filter allows the user to specify a custom slice of data for analysis by simply picking the desired members from the dimension hierarchy. To pick a member, use the checkbox near its name or select a group of members with a context menu command.

Note:

Picking the highest level (All) item does not lead to selecting all of its child elements.

The member choice form has a Tab Panel **(1)**, with each of the tabs providing an area for filter settings and an additional area **(2)** used to display the custom member properties.



the from's areas are described in the table below:

Area	Description
(1)	**Members** is the main tab of the Member Choice Control filter window. It provides the user with the hierarchical members' structure based on the levels' structure of the hierarchy. Here the user can view and modify members.
	Find is a tab that allows the user to apply the conditions used to search for members. This tab also displays the list of members that satisfy the given criteria.
	Selected is a tab used to display all the members chosen manually by the end user.
(2)	**Custom Properties** are used to display the custom properties of the current member.

The user can switch between tabs to use the services provided by the Member Choice Control filter for simpler search of the required members.

To view the non-filtered layout, uncheck the **Member choice** field. In this case, the filter settings are saved but not applied.

The following paragraphs describe the most interesting and useful capabilities, functions, and services of the Member Choice Control filter.

Dynamic data loading

Dimension hierarchies can sometimes contain up to several hundred thousand members on a single level making it extremely hard for the user to manipulate them. That is why all forms use the dynamic data loading by separate blocks containing one hundred members each (100 is the default value that can be modified by the system Administrator). A special **Load next…** item in the members tree is shown to inform the user about that not all data is currently displayed in the list. Double left button mouse click on this item loads the next block of data containing one hundred members.

Icon	Command	Description
	Load next…	A special tree item indicating that not all members of the current level are loaded into the Member Choice Control filter window.
	Load all	A special item informing the user that all members of the level are already loaded into the current tab.

Custom Member Properties View

The user can easily view all custom properties of the selected member in a special area.

This area can be found on the right side of the Member Choice window after clicking the button called **Show Custom Member Properties**. To hide the area, click the button one more time.

Clicking on a member displays all its custom properties.

5.2.1. Member Choice Initialization

Member Choice Control filter area can be accessed by the user either when preparing filters for a new report in the Pivot table designer or when modifying the filters for a previously saved report being reused. The first scenario is pretty simple as it has no input parameters and no preliminary actions are required before initializing the form. The second scenario is managed as shown in the following algorithm:

1. Check the input parameters and exclude incorrect members from the package;
2. Mark the member in the tree to inform the user that the member is chosen;
3. Add this member to the list of selected members and set the appropriate state for it.

Input parameters control

Sometimes, the data stored in the dimensions of the cube can be updated. When reusing a previously saved report, some items used for filter settings can be not present in the cube's data anymore. Input parameters control is launched automatically while initializing the Members tab. An MDX query based on the filter settings is sent to the data source, and the response is compared to the original data set. If any of the items from the filter is not found in the cube, the user is informed about it with a icon right on the main toolbar.

All events of this process are saved in a separate history available to the user in the **Selected** tab via the ⚠ button.

> *Note:*
>
> *Input parameters control is especially useful when the Pivot table designer is configured programmatically and is launched from a third-party application, which can leads to various errors in input parameters.*

Due to the input parameters control, all the members sent as parameters and not found in the cube are excluded and not processed while initializing the items tree.

Items tree initialization

For all the dimension member that passed the input parameters control, the set of all their parents members up to the highest level is formed. It allows the user to see that there are selected members somewhere in the deeper levels of the items tree even when viewing the highest level. The **Selected** tab provides the opportunity to see the overall list of selected members.

The functionality of the Member choice window is described below.

5.2.2. Members tab

The **Members** tab is used to provide the opportunity to select the dimensions' members. It shows the members of the chosen hierarchy in the form of a tree and contains the toolbar with all the necessary commands to process the selected members. In here, processing means:

- Picking an item manually;
- Selecting one or several members via the commands of the tree items context menu;
- Deselecting one or all members;
- Viewing the custom member properties;
- Choosing a level to switch between different levels in the hierarchy.

Level selection allows quick switching to viewing members starting from a particular level of the tree.

Members tab toolbar commands

Icon	Command	Description
	Refresh	Uses the data source to refresh all members of the tree
	Select visible	Selects all visible items among those loaded into the tree
	Clear choice	Cancels the filter settings (clears the selection checkboxes for all members)
	Import selected set	Imports the named set into the Members tab; restores the selection results (the selected members with their current state appear in the Selected tab)
	Export selected set	Saves the selected items as a named set to be reused

Read more on how to use the storage of the named sets made of the selected dimensions' members in Reports storage.

Items tree context menu commands

The commands described in the table below allow the user to select a single item or a group of members with just one mouse click.

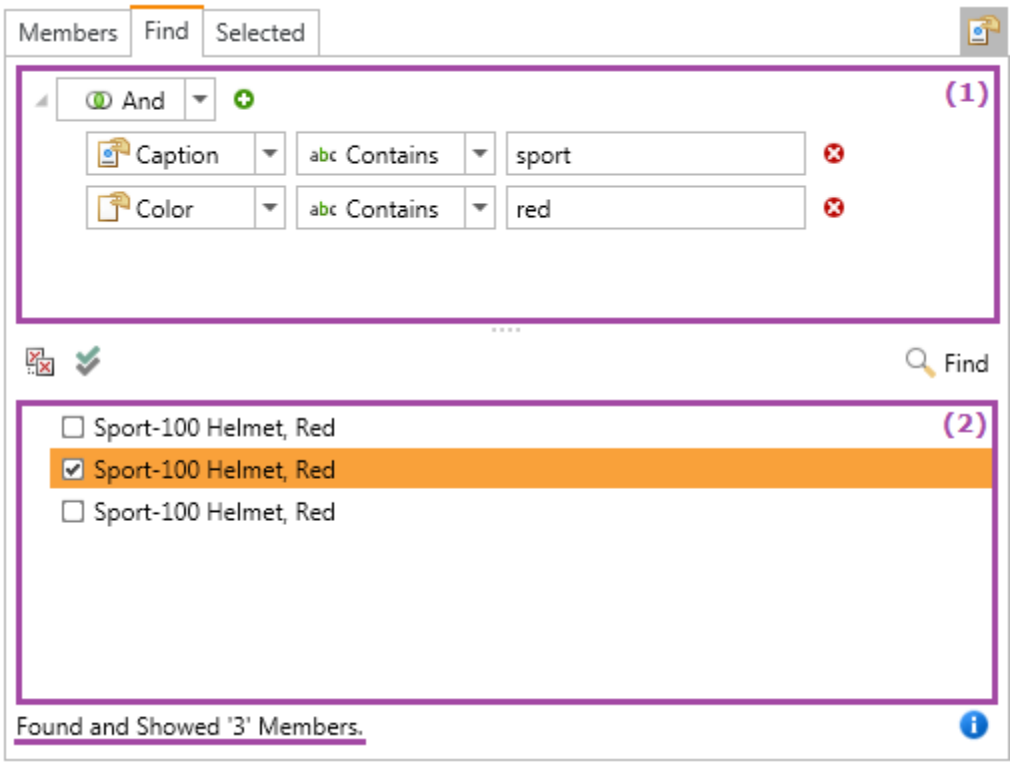
Icon	Command	Description
☐	Not selected	Removes the item from the selection list (clears the checkbox used to pick the member)
☑	This item	Checks the flag used to pick the member and adds the item to the selection list
	Visible	Selects all visible items and adds them to the selection list
■	Child items	Checks the flag used to select the member's child items and adds the member's name into the selection list
	This item + child items	Checks the flag used to select the member together with all its child items and adds the member's name to the selection list
☑	This item + descendants	Checks the flag used to select the member together with all its descendants and adds the member's name into the selection list

Important:

When using the commands Child items, This item + child items, and This item + descendants, only the name of the member itself enters the selection list.

5.2.3. Find Tab

The **Find** tab is intended to find one or several dimension members based on user-defined searching criterion or criteria. The searching process is based upon comparing the member's property value and the given string.



Area	Description
(1)	The area defining the searching conditions
(2)	The area demonstrating the list of members satisfying the searching criteria

The searching conditions can be bound together with AND and OR logic operators to form a group of conditions. The comparison criteria are defined for the custom member properties.

Groups of conditions can be nested, and there are no limits for the number of conditions inside groups.

After setting the searching conditions, click the **Find** button to start the search.

The search results and the total number of members satisfying the searching conditions are displayed in a special area. In this area, the number of the members shown is limited to one hundred. If there are more than 100 members in the search result, the system asks for new searching conditions before showing the total number of the found members.

Search ending

To finalize the search, the needed members should be selected. It can be done by manually picking members one-by-one, via the command that selects all visible items, and through the local menu commands.

The selected items are displayed in the **Selected** tab.

Search management and search results processing commands

Icon	Command	Description

	Clear choice	Removes the checkbox flags from all of the selected members in the search results
	Select visible	Selects all visible items in the search results (visible items are those members added to the list with the search results)
	Search	Launches item search by conditions
		Displays a pop-up window with the searching conditions written in MDX notation

Searching conditions customization commands

The commands are called from the dropdown list for a group of the searching conditions.

Icon	Command	Description
	And	Ties the conditions together when it is required that the data corresponds to more than one searching condition. The conditions are logically bound through the And operator. Returns the TRUE value if all arguments have the TRUE value.
	Or	Ties the conditions when it is required that the data corresponds to any of two or more searching conditions
	Not And	Negative And operator returns the value opposite to the specified one
	Not Or	Negative Or operator
	Add Group	Adds a group allowing to combine several searching conditions in a single logic operation. The number of groups is not limited, and they can be nested.
	Add Condition	Adds a searching condition
	Clear	Clears all settings of the searching conditions

Searching conditions functions

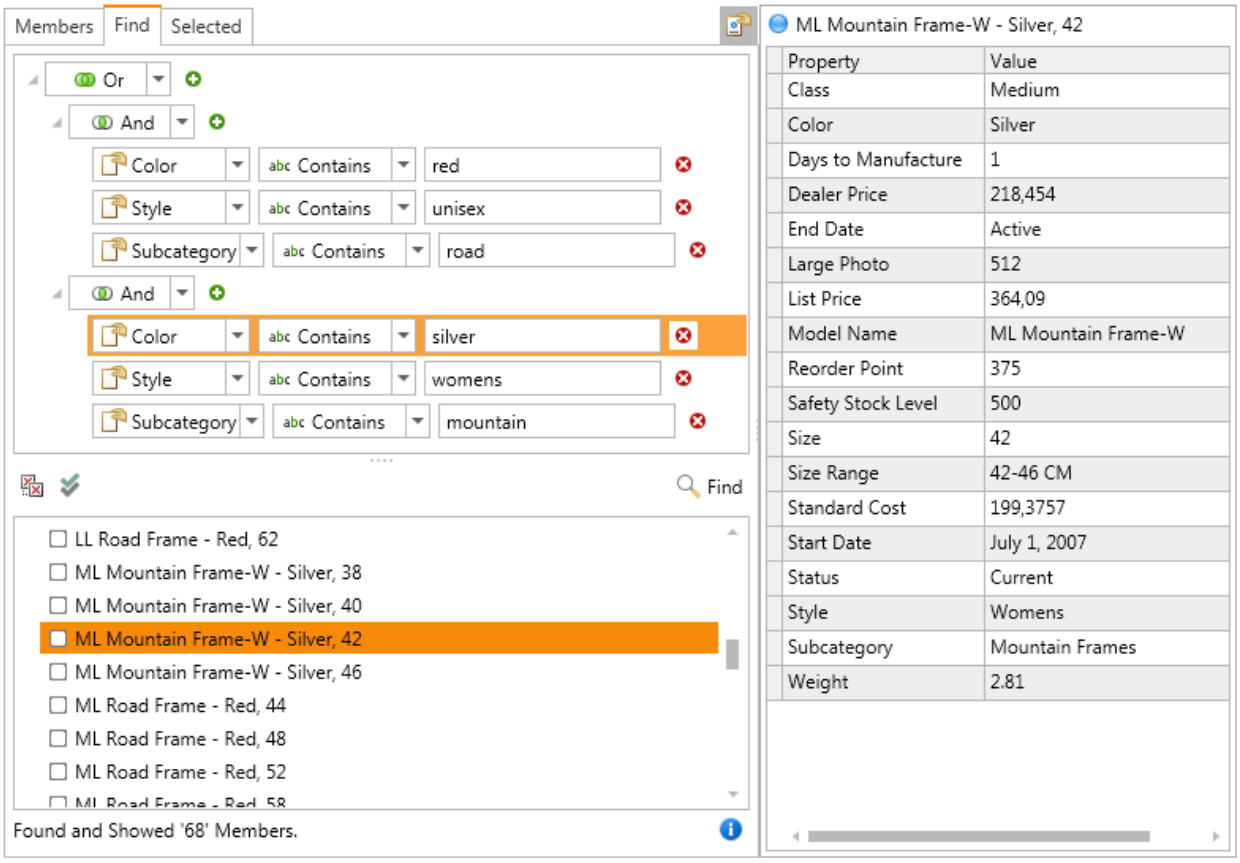
Icon	Function	Description
=	Equals	The text in the value of the property matches the specified string. Properties("Caption") = "bi"
abc	Contains	The text in the property's value contains the specified substring. InStr(1, Properties("Caption"), "bi") > 0

[a]b	Begin with	The text in the value of the property begins with a specified substring Left(Properties("Caption"), 2) = "bi")

Searching conditions setup

Let's examine searching conditions setup in case the filter should utilize several logic operators. The image below shows an example of the searching conditions based on two separate groups; the data can satisfy the conditions present in either of those groups. For example, we search for some products meeting one of the following criteria: ("Subcategory" is "road", "Style" is "unisex", "Color" is "red") or ("Subcategory" is "mountain", "Style" is "women", "Color" is "silver").

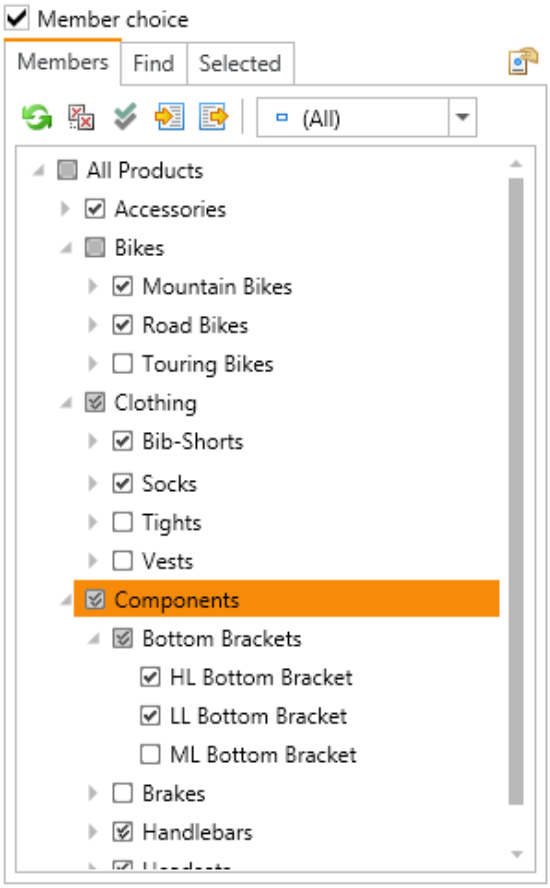
1. To bind the groups, use the **OR** logic operator;
2. In the local menu, find the **Add Group** command and click it. Now, the searching conditions received a child node for the group of conditions tied with an **AND** logic operator. When creating a group, the condition is added there automatically. To use two groups, add the second one at this stage;
3. Set the searching conditions for each of the groups to the desired values of the **Subcategory**, **Style**, and **Color** properties. Add the missing conditions to each of the groups and separately for each of the conditions:
    a. Choose the required property (**Subcategory**, **Style**, **Color**);
    b. Select the comparison operator to define the filtering condition (**Contains**);
    c. Enter the text for comparison (red, unisex, road) for the first searching conditions group and (silver, women, mountain) for the second one.
4. Click the **Find** button to start the searching process.

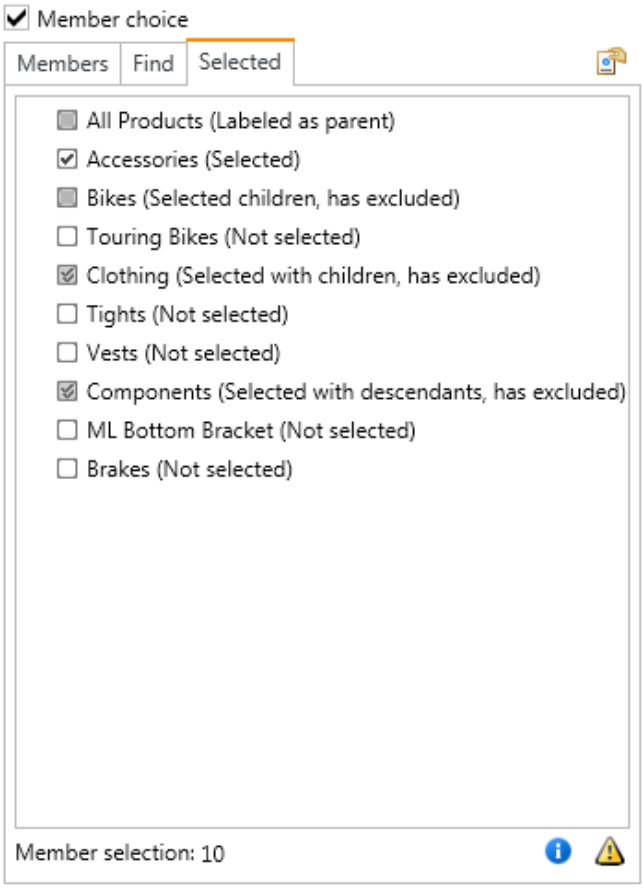


5.2.4. Selected Tab

The **Selected** tab displays the list of selected members used to form the search result after closing the window by clicking **OK**.

Various filter settings are shown in the picture below.





The filter in the given example was created as follows:

1. **This item** command is used to pick [Accessories] as a separate item;
2. **Child items** command is used to select all child items of [Bikes];
3. [Clothing] is selected together with its child items via the **This items + child items** command;
4. [Components] is selected together with its descendants by the **This items + descendants** command;

The next steps are

5. Removing [Touring Bikes] from the child items of [Bikes];
6. Removing [Tights] and [Vests] from the descendants of [Clothing];
7. Removing [ML Bottom Bracket] and [Brakes] from the child items of [Components] on all hierarchical levels;

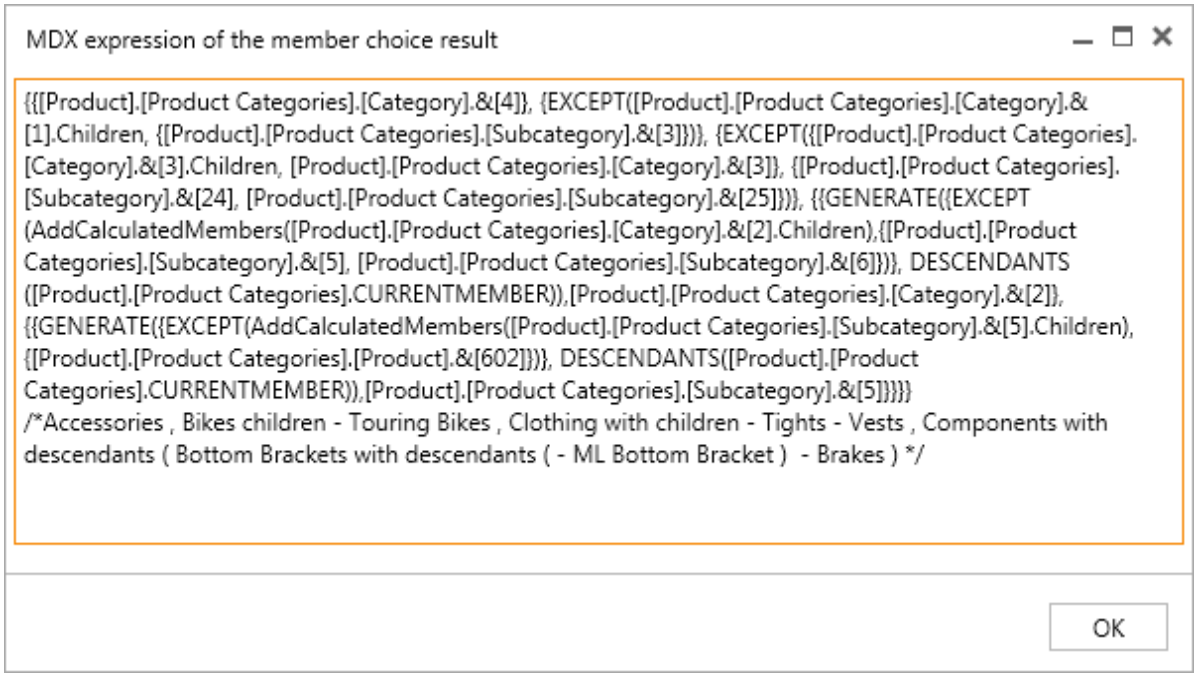
Finally, the filter settings applied by the user form the result seen in the **Selected** tab. It can be noticed that those parent items having some of their child items removed from the layout are marked with the icons to inform the user about these exceptions.

The [All Products] item in the selection list is **Labeled as parent**. The members in this state are not included into the search results; however, they inform the user that there are selected members somewhere throughout their hierarchy levels. For example, when reusing the report with the preset filters, the items tree in the **Members** tab is folded, so the user sees only the [All Products] item (not the members from the child levels). The icon on the [All Products] item informs the user that filters are already applied to the data in the layout.

The commands of the Selected tab

Icon	Command	Description
	Info	Displays a pop-up window with an MDX query that forms the search result; the description of the filter settings is also shown in there.
	Log	Displays a pop-up window with the logs including filter parameters, the input parameters control checkout results and so on.

In the given example, filter settings as an MDX query and the user-friendly verbal description can be viewed through the **Info** command in a special pop-up window:



Search result	Content
Filter definition	/*Accessories , Bikes children - Touring Bikes , Clothing with children - Tights - Vests , Components with descendants (Bottom Brackets with descendants (- ML Bottom Bracket) - Brakes) */
Multidimensional expression	{{[Product].[Product Categories].[Category].&[4]}, {EXCEPT([Product].[Product Categories].[Category].&[1].Children, {[Product].[Product Categories].[Subcategory].&[3]})}, {EXCEPT({[Product].[Product Categories].[Category].&[3].Children, [Product].[Product Categories].[Category].&[3]}, {[Product].[Product Categories].[Subcategory].&[24], [Product].[Product Categories].[Subcategory].&[25]})}, {{GENERATE({EXCEPT(AddCalculatedMembers([Product].[Product Categories].[Category].&[2].Children),{[Product].[Product Categories].[Subcategory].&[5], [Product].[Product Categories].[Subcategory].&[6]})}, DESCENDANTS([Product].[Product Categories].CURRENTMEMBER)),[Product].[Product Categories].[Category].&[2]}, {{GENERATE({EXCEPT(AddCalculatedMembers([Product].[Product Categories].[Subcategory].&[5].Children),{[Product].[Product

	Categories].[Product].&[602]})}, DESCENDANTS([Product].[Product Categories].CURRENTMEMBER)),[Product].[Product Categories].[Subcategory].&[5]}}}}

5.3. FILTER BY CONDITION

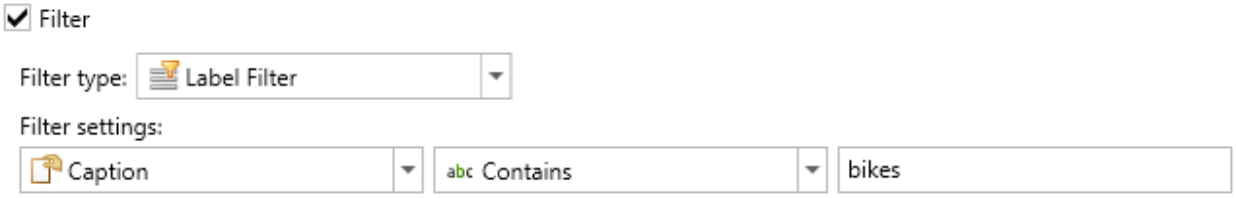
5.3.1. Text filter setup

Text filters allow searching for text data (strings) matching the given conditions.

Each dimension member item has system properties specified as a string and available for using in the text filter settings:

- UniqueName;
- Name;
- Caption.

If a dimension member has custom properties, they are added to the system ones extending the number of properties for filtering.



Text filter creation

To search data using a filter:

1. In the filter settings, select the **Label Filter** filter type;
2. In the dropdown list, select the property of the dimension member;
3. In the next dropdown list, choose the comparison operator to define the searching condition. All conditions are described in the table below;
4. Input the text for comparison.

For example, to filter the product subcategories that contain “bikes” in their description:

1. Select the **Caption** property;
2. Choose the **Contains** condition;
3. Input **bikes** to the comparison field.

Icon	Condition	Description
=	Equals	The property’s text value matches the given string. Properties("Caption") = "bi"
≠	Is not equal	The property’s text value does not match the given string.

		Properties("Caption") <> "bi"
>	Is greater than	The property's text value exceeds the given limit. Properties("Caption") > "bi"
≥	Is greater than or equal to	The property's text value equals or exceeds the given limit. Properties("Caption") >= "bi"
<	Is less than	The property's text value is less than the given number. Properties("Caption") < "bi"
≤	Is less than or equal to	The property's text value is less than or equal to the given one. Properties("Caption") <= "bi"
	Is between	The property's text value is in the range between the given numbers (including those numbers). If the property value matches the given number, then the member satisfies the searching condition. (Properties("Caption") >= "bi") AND (Properties("Caption") <= "clo")
	Open Interval	The property's text value is in the range between the given numbers (excluding those numbers). If the property value matches the given number, then the member does not satisfy the searching condition. (Properties("Caption") > "bi") AND (Properties("Caption") < "clo")
	Is not between	The property's text value is outside the range specified in the filter (including the boundary values). If the property value matches the boundary one, then the member satisfies the searching condition. (Properties("Caption") <= "bi") OR (Properties("Caption") >= "clo")
	Not a Closed Interval	The property's text value is outside the range specified in the filter (excluding the boundary values). If the property value matches the boundary one, then the member does not satisfy the searching condition. (Properties("Caption") < "bi") OR (Properties("Caption") > "clo")
[a]b	Begins with	The property's text value begins with the specified substring.

		Left(Properties("Caption"), 2) = "bi")
[a]b	Does not begin with	The property's text value does not begin with the specified substring. Left(Properties("Caption"), 2) <> "bi")
b[c]	Ends with	The property's text value ends with the specified substring. Right(Properties("Caption"), 2) = "bi")
b[c]	Does not end with	The property's text value does not end with the specified substring. Right(Properties("Caption"), 2) <> "bi")
abc	Contains	The property's text value contains the specified substring. InStr(1, Properties("Caption"), "bi") > 0
acb	Does not contain	The property's text value does not contain the specified substring. InStr(1, Properties("Caption"), "bi") = 0

Unprintable characters can block the substring-based filtering. For example, using the tabulation symbol (the user can occasionally copy and paste it into the field) that looks very similar to several spaces. If you have such issues, contact the cube designer.

Important:

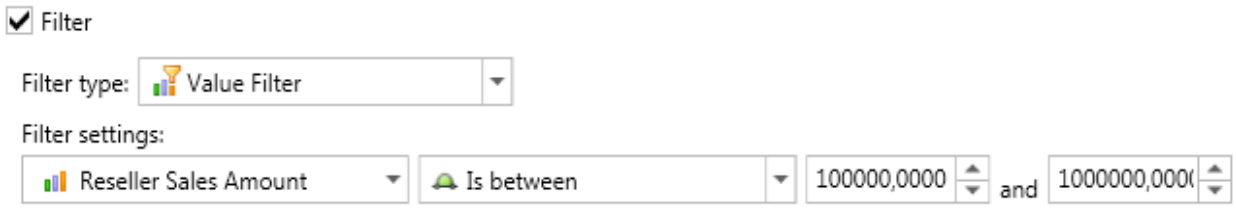
Substring text filtering ignores the letters case.

To go back to the non-filtered layout, uncheck the flag in the **Filter** field.

5.3.2. Value filter setup

Value filters are used to search for data matching the searching conditions among the measures of the cube.

The parameters to set up the filter are taken from a special dimension of the cube called [Measures]. For more info, refer to the Cube browser section.



Creating a value filter

To search data using a filter:

1. In the filter settings, select the **Value Filter** filter type;
2. In the dropdown list, select the measure to be used for the search;
3. In the next dropdown list, choose the comparison operator to define the searching condition. All conditions are described in the table below;
4. Enter the number used to filter data. To search for measures in a specified range, enter two values (min and max). The user should check that the max value exceeds the min one.

For instance, to filter the goods sold via a particular dealer in the range between 100K and 1000K:

1. Pick the **[Reseller Sales Amount]** measure in the [Reseller Sates] measure group;
2. Set the **Is between** condition;
3. Enter the maximal and minimal boundary values (100000 and 1000000).

Icon	Condition	Description
=	Equals	Filter settings are applied to the cube measures whose values match the specified one.
≠	Does not equal	Filter settings are applied to the cube measures whose values do not match the specified one.
>	Is greater than	Filter settings are applied to the cube measures whose values exceed the specified one.
≥	Is greater than or equal to	Filter settings are applied to the cube measures whose values match or exceed the specified one.
<	Is less than	Filter settings are applied to the cube measures whose values are less than the specified one.
≤	Is less than or equal to	Filter settings are applied to the cube measures whose values are less than or equal to the specified one.
	Is between	Filter settings are applied to the cube measures which values are in the range between two specified values (including the boundary values). If the cell value is equal to the boundary one, it satisfies the searching condition.
	Open Interval	Filter settings are applied to the cube measures whose values are in the range between two specified values (excluding the boundary values). If the cell value is equal to the boundary one, it does not satisfy the searching condition.

	Is not between	Filter settings are applied to the cube measures whose values are outside the range specified with two given values (including the boundary ones). If the cell value is equal to the boundary one, it does not satisfy the searching condition.
	Not a Closed Interval	Filter settings are applied to the cube measures whose values are outside the range specified with two given values (excluding the boundary ones). If the cell value is equal to the boundary one, it satisfies the searching condition.

Custom calculated members cannot be used in value filter settings.

The number used to filter data can be specified up to four decimal places. However, the default layout of the pivot table displays only two decimal places. That is why the user can sometimes get an unexpected result when setting the filter based on the values from the pivot table. To find the real value of the cell, use the Properties command in the cell context menu. Read more in Properties. The cell value is displayed in the Value property while the formatted value is in the FORMATTED_VALUE one.

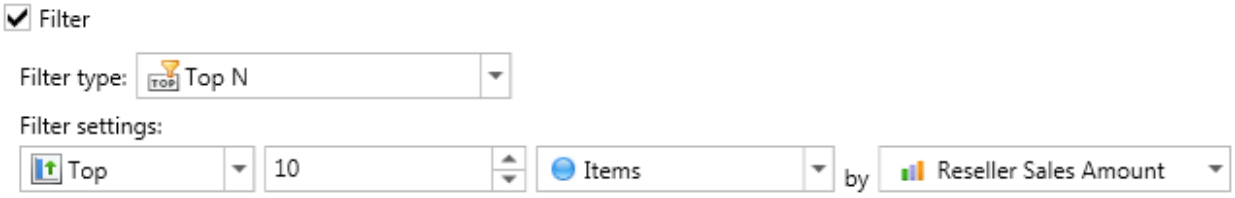
Important:

When setting a value filter, pay attention to the fact the pivot table displays the formatted values only (the FORMATTED_VALUE property).

To go back to the non-filtered layout, uncheck the flag of the **Filter** field.

5.3.3. Top N filter setup

Top N filters are used to find data based on the top and bottom values. The searching conditions are defined by various functions whose input parameters are specified by the user.



Creating a filter for Top N items

1. In the filter settings, pick the **Top N** filter type;
2. Choose the method used to sort the members: **Top** or **Bottom** property values;
3. Enter the number of the items to search for;
4. Set the rule to **Items**;
5. Select the measure.

Creating a filter for Top N percent from totals

1. In the filter settings, pick the **Top N** filter type;
2. Choose the method used to sort the members: **Top** or **Bottom** property values;
3. Enter the number to set the percent of the total sum;
4. Set the rule to **Percent**;
5. Select the measure.

Creating a filter for Top N sums

1. In the filter settings, pick the **Top N** filter type;
2. Choose the method used to sort the members: **Top** or **Bottom** property values;
3. Enter the number used to define the total sum;
4. Set the rule to **Sum**;
5. Select the measure.

The filter setting details are described in the tables below.

The parameters define the order of sorting the members in the original data set, as well as the rules of forming the resulting layout:

Icon	Parameter	Description
	Top	Filters the data from top to bottom and returns a set of top values. Functions TopCount, TopPercent, TopSum
	Bottom	Filters the data from bottom to top and returns a set of bottom values. Functions BottomCount, BottomPercent, BottomSum

The parameters define the rules of creating the resulting tuple:

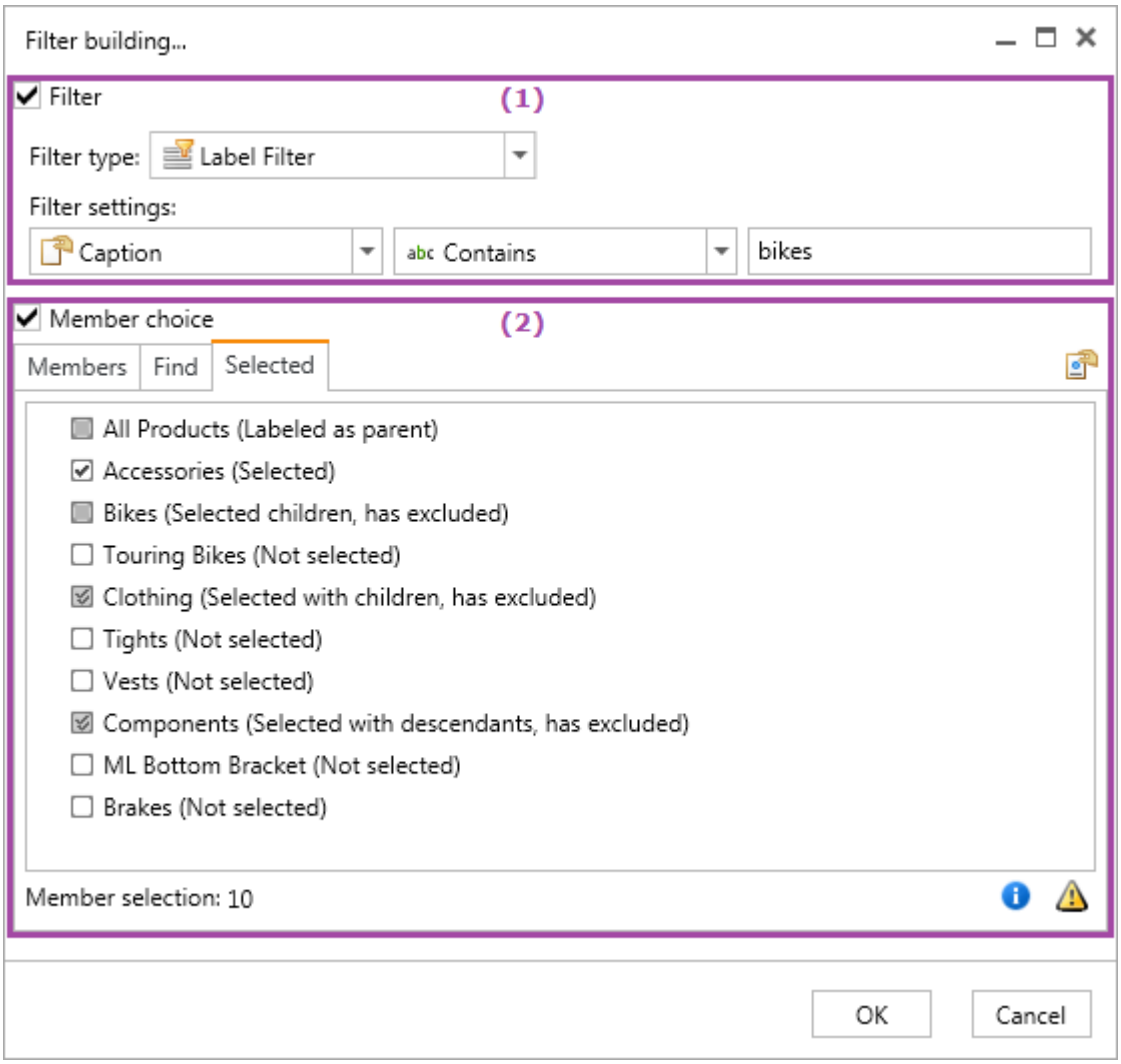
Icon	Parameter	Description
	Items	Returns the specified number of items from the sorted tuple (sorted set). Functions: • TopCount — takes max values; • BottomCount — takes min values.
%	Percent	From the sorted tuple (sorted set), returns the items whose total percentage matches the searching condition. Functions: • TopPercent — gets the percentage that exceeds or is equal to the specified value;

		• BottomPercent — gets the percentage that is less or equal to the specified value.
Σ	Sum	From the sorted tuple (sorted set), returns the items whose total sum satisfies the searching condition. Fucntions: • TopSum — gets the sums exceeding the specified value or being equal to it. • BottomSum — gets the sums being less or equal to the specified value.

5.3.4. Composite filter (extended filter)

The extended filter combines the settings of **Value** and **Member choice** filters.

The extended filter is used when setting up a filter for cells in the Rows and Columns areas of the Pivot table designer. For the Active Filters area, only the **Member choice** filter is available.



The dialog window of the Extended filter settings has the following areas:

Area	Description
(1)	The area is for setting a Value filter. Read more in Filter by conditions.
(2)	The area is for settings a Member choice filter. Read more in Member Choice Control.

Any of the filters included in the extended filter can be enabled/disabled through (un)checking special checkboxes:

- **Filter** — for a Filter by condition;
- **Member Choice** – for a Member Choice Control filter.

When the flag is unchecked, the settings of the filter are saved but not applied to the data layout display. When the flag is checked, the settings of the filter are active and can be modified by the user.

If the **Member Choice Control filter** is active, its settings are used to form the **Filter by condition**.

5.4. FILTERS FOR HIERARCHIES AND LEVELS

Icon	Command	Description
	Filter to level	Add a level filter
	Top filter	Add a Top N filter
	Group filters	Add a group of filters
	Label filter	Add a text filter (label filter)
	Value filter	Add a value filter

Llogic operations that combine several groups of filters and/or conditions in a single logic expression written as an MDX query:

Icon	Operator	Description
	AND	Binds a group of filters or several conditions when it is required that the data should satisfy all searching conditions.
	OR	Binds a group of filters or several conditions when it is required that the data should satisfy at least one of the searching conditions.
	Not AND	Reversed AND operator
	Not OR	Reversed OR operator

5.5. ADDITIONAL INFO ON DATA FILTERS

Using filters can be problematic or totally impossible due to the following reasons:

1. If a hierarchy is specified in the Pivot table designer, Filters by condition cannot be applied to the data. Only member from the highest level of the hierarchies end up in such filters. When the drilldown operation is used on the member, no child members are filtered and shown according to the searching conditions. Filters by condition are applied only to levels. When a total sum of the filtered level is needed, use the custom calculations editor;

Note:

*In Ranet Tools 3.9 a new logic was implemented in **Filters for hierarchy level** removing all limitations regarding using any of the **Filters by condition.***

2. Custom calculated members cannot be used in Filters by condition (they cannot be picked from the measures of the cube). Filtering them is available only via custom calculations editor;
3. If the pivot table designer was initialized with a programmatically applied data filter as a Subcube, this Subcube is automatically applied when viewing the metadata tree in the Cube browser, when setting the Member Choice Control filter in the members tree, and when loading the report from the Report storage;
4. If the pivot table designer was initialized with a programmatically applied data filter as a Tuple, the filter settings from this Tuple are used to replace the original settings in the reports loaded from the Settings storage. It allows using the same reports with different parameters sent to the pivot table designer from the portal or another application.

6. CUSTOM CALCULATIONS

6.1. OVERVIEW

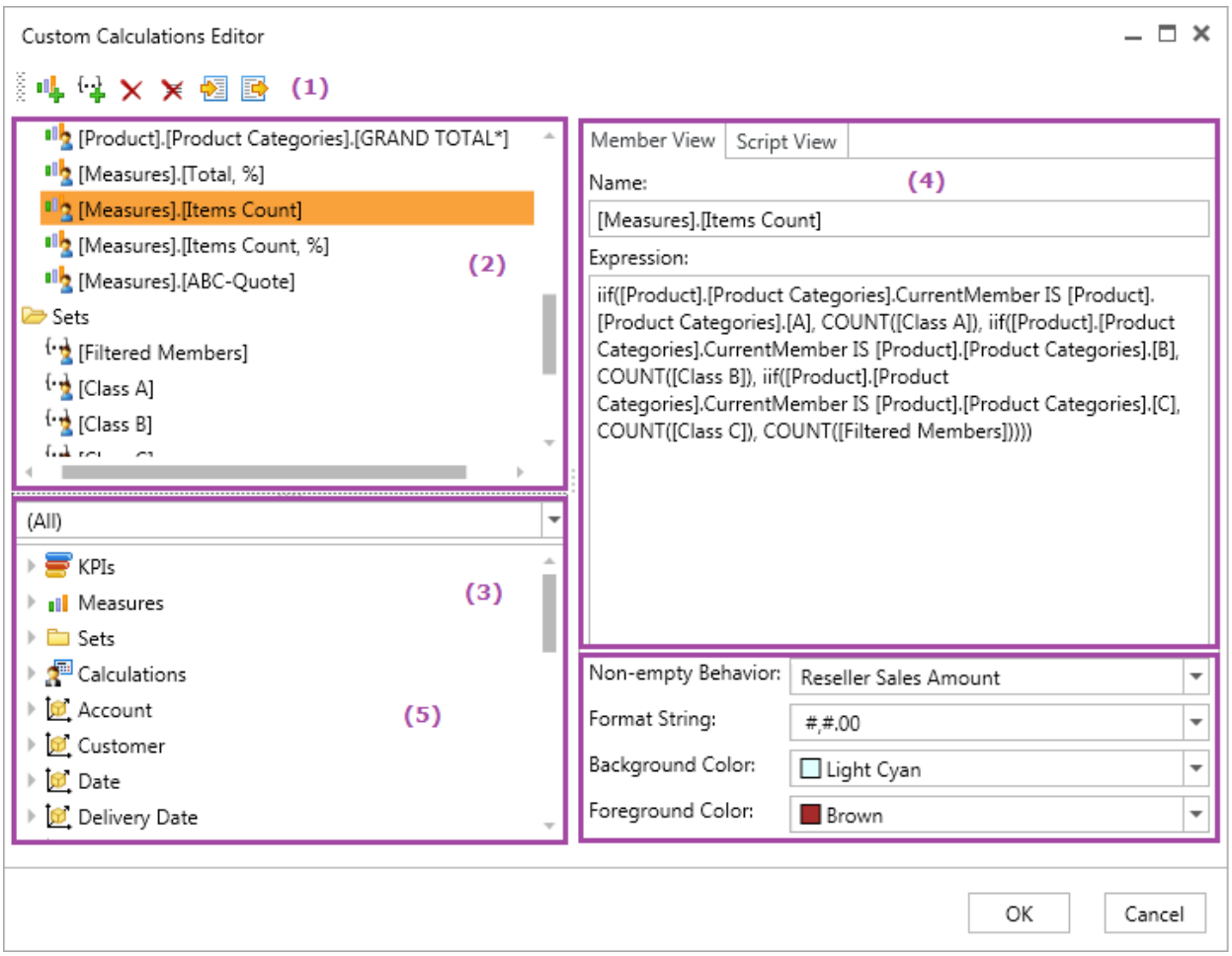
If the reported sums and other calculated values from the cube are not enough for the detailed data analysis, the end user can use custom calculations. In MDX, a calculated member is the value returned as a result of calculating a multidimensional expression. Custom calculations have a great potential for manipulating the data. Calculated members can be created anywhere in the hierarchy. These members can depend not only on the existing cube items, but also on other calculated members introduced in the same multidimensional expression.

Custom calculation is a calculation defined by the end user with the MDX syntax, which can be used to get values anywhere within the MDX query. Custom calculations are limited by the area of the current MDX query; their descriptions and values exist only in memory and are not stored as the cube's data.

Pivot table designer provides the end users with the opportunity to create custom calculated members and named sets and use them in the report settings. Custom calculations are set up in the Custom Calculations Editor that has a cube's metadata browser and calculation formatting settings. Developers, system administrators, and business analysts with relevant skills can create custom calculations using all the powers of MDX. The configurations can be saved in the centralized file storage on the web application's server. End users that lack technical skills can load these custom calculations configurations and use them as templates.

6.2. CUSTOM CALCULATIONS EDITOR

Click the Pivot table designer toolbar button to open the Custom Calculations Editor dialog window.



Custom Calculations Editor form consists of five main areas:

Area	Description
(1)	The toolbar contains buttons for the most common functions required to manipulate the custom calculations.
(2)	This area displays the list of the custom calculations.
(3)	The Cube browser provides access to the cube's (meta)data.
(4)	This area contains the custom calculation's description: the unique name and the calculation as an MDX query.
(5)	The area contains the script settings and formatting.

Toolbar allows using the commands for custom calculations.

Custom Calculation List shows all custom calculations. They are split into two categories:

1. **Members** for calculated members;
2. **Sets** for named sets.

Cube Browser displays the cube's (meta)data to provide access to the whole cube's structure (including dimension members) used to build custom calculations. It shows dimensions, hierarchies, levels, and

member elements. It is helpful when creating custom calculations as they need to be defined in the terms of MDX syntax.

Taking the items from the metadata area is performed via simple Drag and Drop.

The **Calculations** node in the metadata tree contains custom calculations (from the (2) area) to provide the opportunity to use any of the custom calculations to define other custom calculations.

Custom Calculation contains the description of the custom calculation and is formed by two tabs:

1. **Member View** is for custom calculation configuration setup. The user should specify:
    a. The unique name of the custom calculation (the **Name** field). The name of the custom calculation should follow the rules of creating identifiers, and the calculation itself should be written in correct MDX syntax. Typical syntax of a calculated member name is [Dimension].[Hierarchy].[Parent name].[Custom Member Name], and is described in details later in this tutorial;
    b. The expression used to calculate its value (the **Expression** field) in MDX terms.
2. **Script View** is for viewing the settings of the custom calculation in the MDX format (including the **Options** configurations).

Options store the configurations of the script and the layout. This area allows modifying the format string, the background and the text color to be used in the pivot table displaying the result of the calculation. The settings of the properties are shown in the **Script View** field in the MDX format.

The commands to manipulate the custom calculations:

Icon	Command	Description
	Add Calculated Member	Creates a calculated member.
	Add Named Set	Creates a named set.
	Remove Current Calculation	Removes the current calculation—the item which the cursor is set on. The user can remove calculated members if these members are not used to define other calculated members or in the report.
	Remove all calculations	Removes all calculations.
	Import settings	Allows loading (importing) previously saved custom calculation settings from the server.
	Export settings	Allows saving (exporting) custom calculation settings on the server to use them later.

Read more on how to use the custom calculation storage in the Reports storage section.

6.2.1. Introduction to custom calculations naming syntax

The name of the calculated member should be unique and is defined as a multicomponent identifier (see Identifier in Glossary). The conventional custom calculated member name is [Dimension].[Hierarchy].[Parent name].[Custom Member Name].

Property	Meaning
[Dimension]	The identifier of the dimension which the members belongs to.
[Hierarchy]	The identifier of the dimension hierarchy which the member is bound to. The dimension and the hierarchy are considered indivisible because hierarchies always belong to dimensions (and members are always in the context of their hierarchies). Set the complete name if you need to create an item in any dimension other than the measures dimension. Otherwise, the item is created in the measures dimension.
[Parent name]	The ID of the dimension item which relates to the newly created one as a parent member. When this property is left empty, the newly created member becomes the child item of the [All] item.
[Custom Member Name]	The ID of the calculated member.

There are no strict rules on the syntax of the named sets. The name can be any adequate string expression inside square brackets.

6.2.2. Introduction to using custom calculations

Here are some aspects of using the custom calculations editor:

1. To modify a custom calculation, select it in the list by clicking its name in area (2). Then, use area (4) to specify its Name and Expression;
2. Set the cursor to the needed position in the edited field (either the Name of the Expression);
3. To use the cube's metadata item in modifying calculations, open the corresponding node in the metadata tree and use Drag and Drop to move it to the Name or Expression field of the area (4). The result is adding the text with the unique ID of the selected object (as a rule, it is the UniqueName property) right after the cursor's position in the chosen field.
4. To create a calculated member as an item belonging to a certain dimension hierarchy, add the unique name of this hierarchy to the member's name. Select the required hierarchy in the cube's metadata tree and move the item to the edited field. The conventional syntax of the calculated member's name is [Dimension].[Hierarchy].[Custom Member Name];
5. If the identifier of the calculated member does not contain the unique name of the hierarchy, then it is by default considered as a calculated measure and belongs to the measures dimension [Measures];
6. When creating calculated measures, the name should contain the [Measures] keyword (it is the name of the hierarchy of measures). It is important in case you are going to specify custom styles for this member. Setting up custom styles requires the complete name of the member.

The conventional syntax of the calculated member's name is [Measures].[Custom Member Name];

7. Calculated members can be created in any point of the hierarchy. To create a calculated member as a "child" of a dimension item, its ID should contain the unique name of the parent element. The conventional syntax of the calculated member's name is [Dimension].[Hierarchy].[Parent name].[Custom Member Name];
8. Calculated members do not necessarily depend on the existing cube's items. They can also be created based on other calculated members. To use a custom calculation inside another custom calculation, select the Calculations node in the metadata area (3), find the calculated member, and move it to the Expression field in area (4);
9. For members, the arguments of the expression that defines the arithmetic calculations can be presented in the form of any combination of items or fixed numbers, operators, and MDX functions that satisfy the MDX coding standards;
10. For named sets, the arguments of the expression can be:
    a. An array of manually selected items separated by commas;
    b. A range of items selected by two elements (one to define the bottom boundary and the second—for the top one) separated by a colon;
    c. An MDX function returning a member or a set of members.

Note:

This guide does not contain information about MDX syntax and functions. It can be found in the original MDX Function Reference (https://msdn.microsoft.com/en-us/library/ms145970.aspx and https://msdn.microsoft.com/ru-ru/library/ms145970.aspx) on the official Microsoft site.

6.2.3. Creating Calculated Members

A calculated member is a member created through calculating a multidimensional expression that returns a value. It is possible to create custom measures or dimension items called calculated members by means of the cube data, arithmetic operators, numbers, and functions. For example, there can be a calculated member called "Euro" to convert dollars into euros by multiplying the measure of dollars and the converting rate.

To create a calculated member:

1. In the toolbar of the Custom Calculations Editor dialog window, click the Create Calculated Member / Add Calculated Member button;
2. In the Name field of area (4), set the unique name of the custom calculation:
    a. If a calculated measure belonging to the measures dimension is created, the name is formed as [Measures].[Calculated Member Name]
    b. If the calculated member of any other dimension is created, the name is formed as [Dimension].[Hierarchy].[Calculated Member Name]
    c. If a child calculated member is created for an item in the hierarchy, the name is formed as [Dimension].[Hierarchy].[Parent name].[Calculated Member Name]
3. In the Expression field of area (4), set the expression used to calculate the value of the calculated member. The arguments of the expression can be any combinations of members or fixed numeric values, operators, and MDX functions that match the coding standards of the MDX;

4. In the Non-empty Behavior, set the measure or the set of measures used to define the behavior of the calculated members when processing empty cells;
5. In the Format String, specify the format string used to display the result of the custom calculation. Read more about format strings in the original source on the official Microsoft site. The configuration of the format strings can be chosen from the list of available ones or created manually;
6. In the Background Color field, select the color for the background of the cell where the calculated member will be shown;
7. In the Foreground Color field, choose the text color for the cell where the calculated member will be shown.

Here are some examples of custom calculations created on the basis of the demo Adventure Works database.

1. Define the [Measures].[Special Discount] calculated member used to calculate a special discount based on the initial discount amount [Measures].[Discount Amount].
    a. Select the [Measures].[Discount Amount] item in the cube's metadata tree and move it to the Expression field
    b. Complement it with the *** 1.5** text. The result is shown below:

Name	Expression
[Measures].[Special Discount]	[Measures].[Discount Amount] * 1.5

2. Calculated members can be created in any place of the hierarchy. For example, the following multidimensional query defines the [Successful Year] calculated member used to find if more than 20000.00 bikes were sold in a year. The [Successful Year] calculated member is created in the query not as a descendant of the [Product] dimension but as a child of the Bikes item: [Product].[Product Categories].[Category].&[1].

Name	Expression
[Product].[Product Categories].[Category].&[1].[Successful Year]	IIF([Product].[Product Categories].[Category].&[1] > 20000.0, "Yes", "No")

3. Calculated members do not necessarily depend on the existing cube's items. Calculated members can be created based on other calculated members specified in the same multidimensional expression. For example, the following multidimensional query uses the value created in the first calculated member ([Measures].[Special Discount]) to form the value of the second calculated member ([Measures].[Special Discounted Amount]).

Name	Expression	Properties
[Measures].[Special Discount]	[Measures].[Discount Percentage] * 1.5	FORMAT_STRING = 'Percent'
[Measures].[Special Discounted Amount]	[Measures].[Reseller Average Unit Price] * [Measures].[Special Discount]	FORMAT_STRING = 'Currency'

Read more at https://technet.microsoft.com/ru-ru/library/ms146017.aspx

Note:

This guide does not cover MDX syntax and functions; for more information, use the original source—the MDX Function Reference (https://msdn.microsoft.com/en-us/library/ms145970.aspx and https://msdn.microsoft.com/ru-ru/library/ms145970.aspx) on the official Microsoft site.

6.2.4. Creating Named Sets

A named set is a set of dimension members or an expression of such set created for multiple use in MDX queries. Named sets can be created upon any combinations of the cube data, arithmetic operators, numbers, and functions.

To create a named set:

1. In the toolbar of the Custom Calculations Editor dialog window, click the Add Named Set button;
2. In the Name field of area (4), enter the unique name of the named set;
3. In the Expression field of area (4) create a multidimensional expression that defines the named set;
4. The expression can contain any of the following objects:
    a. Data expressions that represent the components of the cube (such as dimensions, levels, measures, etc.);
    b. Arithmetic operators;
    c. Numbers;
    d. Functions.
5. The expression can be defined:
    a. Manually, by listing the unique names of the members separated by commas;
    b. By dragging the items from the cube metadata area and separating them by commas;
    c. By specifying a range through setting the first and the last item of the range separated by a column;
    d. By using MDX functions that form the set by choosing the elements to include there.

When creating the expression for the set that contains groups of items from various hierarchies, put those groups inside curved brackets ({}).

Note:

A set can contain several items from the same hierarchy. If the set contains Tuples, each Tuple should contain items of different hierarchies strictly in the same order.

More details in https://technet.microsoft.com/ru-ru/library/ms174559%28v=sql.90%29.aspx?f=255&MSPPError=-2147217396

Here are examples of named sets created using the data from the demo Adventure Works cube.

1. Define a named set of items containing core products. These are the products from the Bike category in the Product dimension. Select the Bikes element in the cube metadata tree and move it to the Expression field.

Name	Expression
[Core Products]	[Product].[Product Categories].[Category].&[1]

2. Define a named set of members with the max number of employees from the hierarchy of the Reseller attribute where it intersects with the set of items in the Number of Employees hierarchy of attributes. MDX Exists function is used.
    a. Enter Exists into the Expression field.
    b. Select the **Reseller** hierarchy in the cube's metadata tree and drag it to the Expression field as an argument of the Exists function. The [Reseller].[Reseller] string is added to the field, and the Exists([Reseller].[Reseller]) expression is formed.
    c. To get all members of the set, use the Members function added to the expression after a dot: Exists([Reseller].[Reseller].Members)
    d. Now specify the second argument of the Exists function. The arguments are separated by a comma (put it into the expression). Then, in the Number of Employees hierarchy, pick the item with the highest number of employees (81 – 100) and drag it to the Expression field as a second argument of the Exists function. Here is the result:

Name	Expression
[Large Resellers]	Exists([Reseller].[Reseller].Members, {[Reseller].[Number of Employees].[Number of Employees].&[3]})

3. Define a named set of members containing Top-30 customers based on the sales amount.

Name	Expression
[Top 30 Customers]	TopCount([Customer].[Customer].[Customer].Members, 30, [Measures].[Internet Sales Amount])

6.2.5. Using custom calculations

Custom calculations are used in the reports designer based on pivot tables, just as any other object of the cube metadata. Named sets can be used in the Rows and Columns areas while calculated members are used in the Data area.

Besides, custom calculations can be used in the MDX query if the query is created manually.

6.2.6. Viewing calculated members

Custom calculations are shown in the Calculations node in the Cube Browser and are marked with a special icon depending on the member's type (calculated member or named set).

6.3. EXAMPLES OF CUSTOM CALCULATIONS

The examples below demonstrate how to use the power of OLAP for detailed data analysis through using custom calculations. Custom calculations are created based on the data provide by the [Adventure Works] cube.

1. Sparkline;

2. Time-related operations;
    a. Previous period;
    b. Parallel period;
    c. Moving average;
    d. Period up to a date;
3. Rank calculation.

6.3.1. Sparklines in pivot tables

Sparklines are small diagrams situated in one of the cells of the pivot tables to visualize changing values in terms of time. Sparklines allow monitoring general tendencies and seasonal changes and discovering peak values.

In Ranet Tools library, Sparkline is a type of custom calculated members whose value is expressed in a special format and is shown trough a special Sparkline format string.

The value of a Sparkline calculated member is an array where the points of values are separated with a special "|" symbol.

Let's see an example of a Sparkline showing the dynamics of Network Sales for months of the year.

1. Create a named set [Set All Month] that includes all months of the year. The example uses all months from the Time dimension to make the solution flexible and universal. Later it is possible to use the Filters settings in the Pivot table designer to limit the period for analysis.
2. Create a calculated member [Measures].[Internet Sales Amount Dynamic] to form an array of points of values that would store the amount of the Internet Sales for each month of the analysis period. The algorithm is as follows:
    a. The condition is checked first: are there any sales in the period (if there are no, an empty value is formed).
    b. Generate function is used to create an array of sales for each month; the members of the array are separated with "|".
    c. In the Format String field, the Sparkline format string is set for the item. If the format string is undefined, the value in the pivot table is displayed as a text field.

Name	Expression
[Set All Month]	Descendants ([Date].[Calendar].[All Periods], [Date].[Calendar].[Month])
[Measures].[Internet Sales Amount Dynamic]	IIF(NonEmpty([Set All Month], ([Date].[Calendar].CurrentMember,[Measures].[Internet Sales Amount])).Count > 0, Generate([Set All Month], ([Date].[Calendar].CurrentMember, [Measures].[Internet Sales Amount]), "|") , NULL)

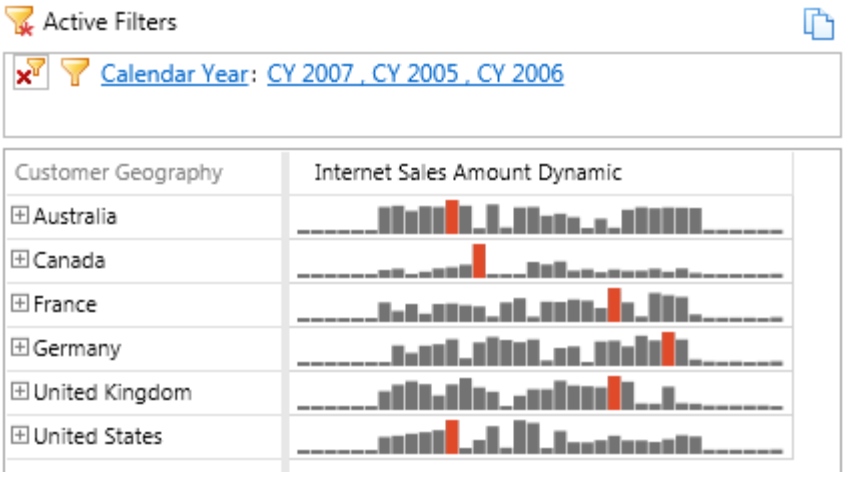
After creating the expressions, use the Pivot table designer to form the report on Internet Sales by countries from 2005 to 2007.

1. Open the [Calculations] node in Cube Browser, find the [Measures].[Internet Sales Amount Dynamic] member and drag it to the Data area;
2. In the Cube Browser, open the [Date] node, then the [Calendar] folder, then the [Date].[Calendar Year] hierarchy, then the [Calendar Year] level and drag it to the columns area. Finally, set the filter for the period from 2005 to 2007;
3. In the Cube Browser, open the [Geography] node, then the [Geography] hierarchy, then the [Country] level and drag it to the Rows area.

By default, sparklines are displayed in the pivot tables as lines. To switch to a bar chart visualization, set a custom style for this calculated member.

1. Open the Cells styles designer;
2. Create a new style with the unique name of [Measures].[Internet Sales Amount Dynamic] (in the Cube Browser, open the [Calculations] node and click the [Measures].[Internet Sales Amount Dynamic] member to add the name to the field automatically;
3. Add the condition of applying the style with the None type. When defining the styles there should be at least one condition, even though it is not required for the Sparkline visualization.
4. In the Sparkline settings, change the visualization type to Bar.

The image below shows the dynamics of the Internet Sales, the red mark is for max value.



Note:

Sparklines cannot be exported to Microsoft Excel tables.

9. MDX REQUEST IN PIVOT TABLE

9.1. SOME NOTES ON MDX REQUEST GENERATION

An automatic MDX request to the OLAP data source is generated according to the current table structure based on fields, Selection Panel filter settings, and the Designer properties.

1. The set of items is formed based on the fields settings in the Rows and Columns areas. The set is embraced by the **HIERARCHIZE** function for each field.
2. The **HIERARCHIZE** function is applied to both axes (COLUMNS & ROWS);
3. The MDX request includes the following default properties:
    a. **DIMENSION PROPERTIES**: PARENT_UNIQUE_NAME, HIERARCHY_UNIQUE_NAME, CUSTOM_ROLLUP, UNARY_OPERATOR, KEY0, MEMBER_TYPE
    b. **CELL PROPERTIES**: BACK_COLOR, CELL_ORDINAL, FORE_COLOR, FONT_NAME, FONT_SIZE, FONT_FLAGS, FORMAT_STRING, VALUE, FORMATTED_VALUE, UPDATEABLE, ACTION_TYPE

    To add extra properties, edit the MDX request manually.

4. When using the **NON EMPTY** key word for the axes while in the **Custom Query mode**, the state of the corresponding buttons in the toolbar should be appropriately synchronized. For example, if the MDX request uses the NON EMPTY for the COLUMNS axis, then the **Hide empty columns** button should be activated.
5. The initialization of the pivot table can automatically use a default Subcube to filter the data showed to the user in the Cube Browser and define the slice for report layout.
6. Custom settings of the fields in the Filters area form a Subcube that is added to the default one.
7. If only one item is selected in the filter settings, then it is also added into the MDX request's WHERE condition. Multiple filters are added to the Subcube only.
8. Custom set filters for the fields in the visible parts of the Rows and Columns areas are added to those filters defined in the Filters area. Together, all filters form a Subcube being added to the default (automatically set) Subcube.
9. User-defined filters for the fields in the visible parts of the Rows and Columns areas cannot be added into the MDX report's WHERE condition. This condition can take only those hierarchies absent in the displayed axes (COLUMNS & ROWS) of the pivot table.
10. If the only measure is selected in the Data area and there are no fields in the Rows area or there are fields both in Columns and Rows areas, then the measure is added to the WHERE condition, i.e. the user doesn't see it among the titles of the pivot table rows or columns.

10. EXTENSION

10.1. OVERVIEW

HTML5, SILVERLIGHT

Pivot table extension allows using diagrams, charts, and geographic maps for better user experience. The extension provides the data analysis process with extra scenarios, more graphic layout, and improved ergonomics. The extension works in pair with the pivot table using the same data.

The analytic dialog window with the pivot table is composed by 4 areas suitable for displaying the extension (top, bottom, left, and right to the pivot table). There are also several modes allowing to occupy all main area with the extension (in such case, only one of the visual elements is visible).

To customize the placement of the extension, choose actions from the drop-down list:

Icon	Command	Result
	Extension only	There is only the extension displayed in the main area
	Extension above Grid	The extension is shown in the main window on top of the pivot table
	Extension below Grid	The extension is placed under the pivot table in the main window
	Extension to left of Grid	The extension is shown to the left of the pivot table in the main window
	Extension to right of Grid	The extension is shown to the right of the pivot table in the main window

	No extension	Only the pivot table alone is displayed

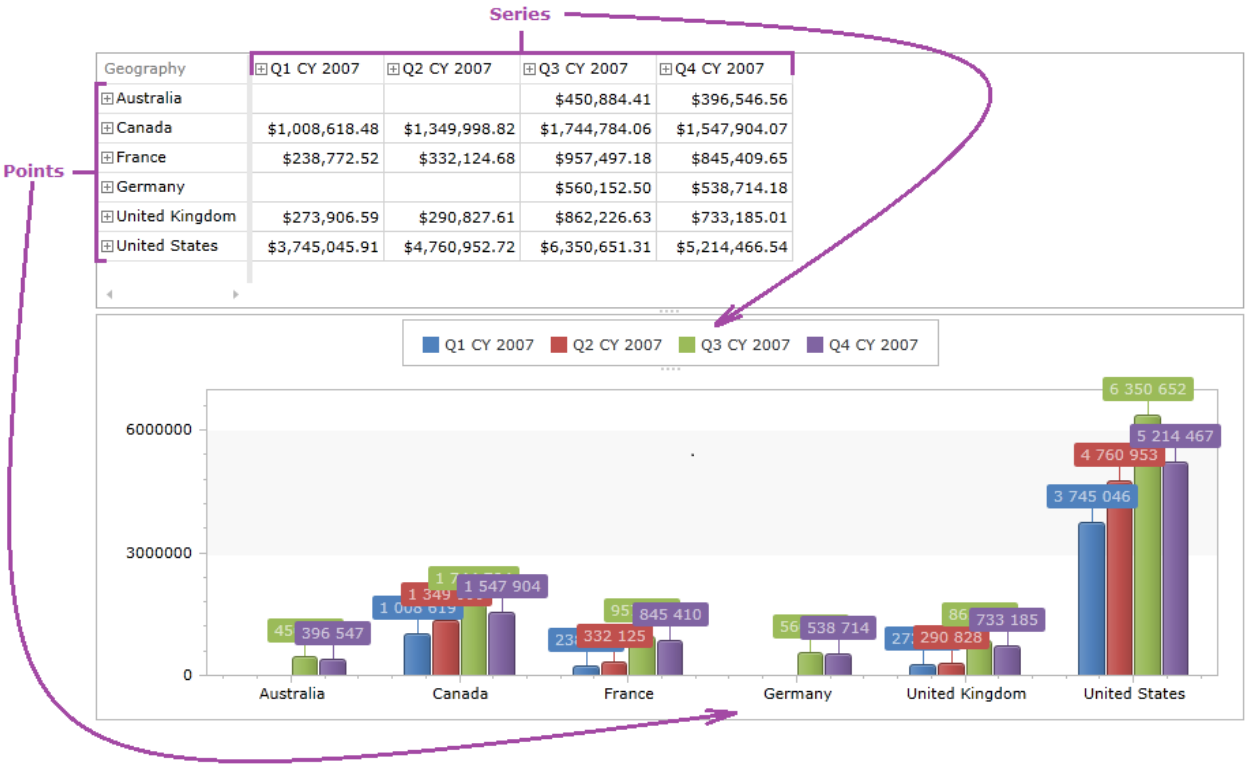
10.2. CHARTS AND DIAGRAMS

The Ranet Tools library includes a significant amount of diagrams and charts providing the user with the ability to utilize various scenarios of data analysis. The user can optimize the visualization for better experience through manipulating the settings and types of charts and diagrams.

Basic functional analytics options:

1. Using various types of diagrams: pie chart, bar chart, histograms, and other graph-based diagrams;
2. Creating complex diagrams by combining several types of diagrams: histograms, bar charts, and pie chart;
3. Inbuilt function that performs the drilldown operation on the OLAP-source-provided data;
4. Export of diagrams' data sources to Microsoft Excel.

The image below demonstrates how the pivot table data is mapped on a diagram. Columns form series; rows form points.



10.3. MAPS

Geographic maps show data on the image of the Earth surface.