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SAP® NetWeaver BW 7.x Reporting—Practical Guide

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The foundation of a quality Business Intelligence (BI) user experience is effective query design.

3 Building Effective Business Warehouse (BW) Queries: The Basics of Query Designer

Once you have a basic idea of which user populations you will be targeting, you can begin creating the building blocks of your BI user experience: queries. Query design is critical, as a little time invested in creating efficient and relevant queries will save you tons of effort down the road.

This chapter will walk you through the basic process of creating a query from scratch using the Business Explorer (BEx) Query Designer tool (found under the BEx folder of your SAP installation). More advanced functionality related to query design will be covered in Chapter 5, Running Queries in Excel: Business Explorer analyzer.

3.1 Where Is My Data Coming From?

A query without data doesn’t provide a whole lot of value to users. Before we begin the process of creating a query, we must first select which InfoProvider the query will be based on. Because this book is focused on the frontend user experience, it is assumed that you already have an InfoProvider such as an InfoCube, MultiProvider, or InfoObject read, but is that InfoProvider the right choice for your query?

3.1.1 Use MultiProviders for Greater Flexibility

When you create a new query, selecting the correct InfoProvider is important, because you’ll have to recreate the query if you change your mind. However, if you use a MultiProvider as a layer of abstraction between the query and the Info-
Providers, you can change the components of the MultiProvider without having to completely recreate your query — although a major change like this might still require some changes to the query design. Even if you are only reporting on a single InfoCube, it may prove beneficial to create a MultiProvider consisting of only that InfoCube in case the backend design changes in the future.

3.1.2 Selecting an InfoProvider

Now that you have an InfoProvider (preferably a MultiProvider) ready to go, you can start creating your query. SAP provides a number of ready-made queries in business content, but you can often get a better grasp on query design by starting from scratch.

Open BEx Query Designer and connect to your BW 7 system. Once you are connected and the blank BEx Query Designer window appears, click the icon at the beginning of the top toolbar to create a new query. The system will prompt you to select an InfoProvider, as seen in Figure 3.1.

![InfoProvider Selection Screen](image)

Click the INFOAREAS button, navigate through your system until you find the InfoProvider in question, and double-click the InfoProvider. The BEX QUERY DESIGNER window will now show information about your chosen InfoProvider in the left pane of the window, as seen in Figure 3.2. In this book, we will be using a Multi-
Where Is My Data Coming From?

3.1 tiProvider containing InfoCubes from cost center accounting and project systems (0CCA_C11 and 0PS_C04) as an example. If you have not implemented project systems, using a cost center accounting cube on its own would also work.

![Query Designer: New Query](image)

**Figure 3.2** Query Designer: New Query

3.1.3 The InfoProvider Pane

The left pane of the BEx QUERY DESIGNER window shows you the STRUCTURES, KEY FIGURES, and DIMENSIONS associated with your InfoProvider. The STRUCTURES displayed in this pane are reusable query components consisting of a number of different selections; we will discuss structures in detail later.

Your InfoProvider’s KEY FIGURES are shown in the BEx QUERY DESIGNER window. This section also holds Restricted Key Figures and Calculated Key Figures, two more types of reusable query components that will be examined later. For now,
examine the available key figures in the InfoProvider and note which ones you’ll want to include in the query.

The Dimensions section of the pane holds the different characteristics of the InfoProvider, organized by dimension as per the InfoProvider’s design. We will be using these characteristics to define restrictions on which data is displayed in the query, including both fixed and variable restrictions. We will also use these characteristics to tell the query which rows and columns to display.

As you’ll see later in the chapter, structures, key figures, and characteristics are all necessary to create a viable query. Characteristics are often used on their own as rows and/or columns, but the core of the query is the structure, which holds selections combining key figures and characteristic restrictions.

3.2 Restricting Data at the Query Level

InfoProviders typically have a very large amount of data, so it is a good idea to set up some high-level data restrictions for your query. The Characteristic Restrictions and Default Values components of BEx Query Designer will help you set up these high-level restrictions. As seen in Figure 3.2, these two panes to the right of the InfoProvider pane will start out blank, but they won’t be empty for long.

We will first discuss the differences between these two components, followed by examples of how to set up different types of restrictions.

3.2.1 Characteristic Restrictions: Set in Stone

The main difference between Characteristic Restrictions and Default Values lies in their flexibility after the report has been run. Items in the Characteristic Restrictions section cannot be changed after query runtime, and are effectively global filters. For example, let’s say we set up a restriction on Business Area 0001 and 0002 in Characteristic Restrictions. When we run the query and try to filter on Business Area, only 0001 and 0002 will be available. The option to remove filter values from Business Area will also be grayed out, because according to the query there are no other Business Areas to show.

Characteristic Restrictions are useful when you want to make sure users of a specific query only have access to a specific set of data. For example, imagine a financial report that will never need to show data outside of Business Area 0001 — you
can safely set up this restriction in the Characteristic Restrictions section, as it will prevent users from seeing data in other Business Areas. However, if you include a variable for a characteristic in Characteristic Restrictions, users will be able to select which characteristic values using the variable screen of the report.

### 3.2.2 Default Values: Set Now, Change Later

The second option for setting up global restrictions, the **Default Values** pane, allows for more flexibility after the query has been run. Restrictions to any characteristic in this pane can be changed by the user after query runtime, as long as the characteristic appears somewhere in the Rows/Columns tab of BEx Query Designer or has a variable associated with it (more on this later).

Expanding on the previous Business Area example, if we set up a restriction on Business Area 0001 in the Default Values pane, and we also include the Business Area characteristic in the Free Characteristics pane of the Rows/Columns tab, users will be able to use the Remove Filter Value or Select Filter Value options on the characteristic after the query is run to see data in other Business Areas.

### 3.2.3 Setting Up Hard-Coded Restrictions

Now that we know the difference between Characteristic Restrictions and Default Values, we can start setting up restrictions on characteristics to narrow down the data being delivered to the query. Restrictions set up in either of these sections will impact the entire query; we will examine restrictions that only affect individual rows or columns later in the chapter.

Let’s say we want to use the Business Area example in Section 3.2.1, Characteristic Restrictions: Set in Stone, and hard-code Business Area 0001 as a Characteristic Restriction so users cannot see data from other Business Areas. The procedure to set up this restriction follows.

**Procedure 3.1: Query-Level Hard-Coded Characteristic Restriction**

1. Locate the Business Area characteristic in the InfoProvider pane on the left by expanding the relevant dimension.

2. Drag the Business Area characteristic over to the Characteristic Restriction panel.
3. Right-click the new Business Area entry that appeared in the Characteristic Restriction pane and select Restrict. The SELECT VALUES screen will appear (see Figure 3.3).

4. Click the SHOW dropdown menu and select SINGLE VALUES.

5. Click one of the Business Area values on the left side. In this example, we will select Business Area 0001.

6. Once Business Area 0001 is selected, click the right arrow button.

7. Now that Business Area 0001 appears in the CHOSEN SELECTION pane on the right side of the dialog box, click OK to confirm.

![Select Values Screen for Characteristic](image)

Business Area will now be in the Characteristic Restriction pane of BEx Query Designer, and if you expand it you can see that Business Area 0001 is now a hard-coded restriction.

By default, BEx Query Designer only shows values contained in the query's Info-Provider. If you'd like to add a restriction on a value that is not yet in the Info-Provider, there is a way to see the entire master data list instead: click the icon at the very top of the Select Values screen, click the Value Restrictions tab, and change Read Mode Setting to Custom, selecting Values in Master Data Table from the dropdown menu. If you wish to always read directly from the master data table, check the Always Use These Settings box and click OK.
3.2.4 Other Options for Restrictions

The procedure in the previous section is relatively basic and only deals with setting a restriction on a single value. To select multiple single values, at step 5 of the previous procedure you can either Shift + click to select multiple contiguous business areas, or Ctrl + click for multiple noncontiguous selections. You can also individually select values and move them over one at a time — double-clicking the value on the left is a shortcut to clicking the right arrow button. If necessary, you can click the Wrench icon at the top right to switch between technical names and descriptions.

If you have a hierarchy built for the characteristic, you can select single or multiple hierarchy nodes in addition to individual values. Select the relevant hierarchy from the Hierarchy dropdown menu to display the hierarchy. Nodes are added to the selection the same way, by either double-clicking them or selecting them and clicking the right arrow button.

The default option for both individual values and hierarchy nodes is to include them in the selection, as indicated by a green equal sign or hierarchy symbol. However, you can also specifically exclude an item from a selection by clicking on the value or node on the right side and clicking the Red Square icon. This will change the appearance of the item to indicate that it is now excluded. You can switch the item back to being included by clicking the Green Circle icon.

Value Ranges are another method for setting up restrictions: in step 4, if you select Value Ranges, you can specify restrictions using relational operators such as Between, Greater Than, or Contains Pattern. As with the Single Values section, you can add multiple value ranges with different operators to the same selection.

If you have a complex selection that you’d like to reuse, you can save it by clicking the Disk icon above the right pane of the dialog box. You can see a list of saved selections by clicking the Show dropdown list and selecting Favorites. When you add a saved selection from the Favorites list, the components of the saved selection will be added to any existing selections you may have already included.

The History option under the Show dropdown list is also very useful, as it will show you the recent selections you have made. You can add items from this list in the same way, just be careful if you are adding nodes from multiple hierarchies, as the history list does not include hierarchy names. The hierarchy names are only visible after you add hierarchy nodes from the history list to the right side.
3.3 Variables

One of the most powerful tools available in BEx Query Designer is the variable. Adding variables to characteristics allows the user to modify the restrictions for several characteristics at once through the variable screen (see Figure 3.4). If a characteristic does not have a variable associated with it, the user must rely on filtering functionality to set up restrictions on that characteristic.

![Sample Variable Screen](image)

**Figure 3.4** Sample Variable Screen

### 3.3.1 Optional versus Mandatory

There are several different settings available for creating different types of variables, but we'll start by looking at the three different options that control which variables must be populated before the query is run:

- A variable with the **Optional** setting does not require the user to enter a value before the query is run.
- The **Mandatory** setting means that the user must enter a value (any value) in the variable before the query can be run.
- **Mandatory (Initial Value Not Allowed)** is the same as Mandatory, except that the user cannot enter # (indicating all data records where the characteristic is not assigned). If the user attempts to enter # into this type of variable, they will see an error message and they will be prompted to enter an actual value. The description of this setting is a little misleading, as it is perfectly fine to assign this type of variable a default value in the query design, but users would not be able to change the default value to # and still successfully run the query.
From a user experience perspective, it is important to map out which variables in your query will have which settings. If any variables in your query are either Mandatory or Mandatory (Initial Value Not Allowed) and do not have a default value assigned, the user will be presented with the SAP variable screen when they try to run the query. The user must then correctly identify the variables that must be filled out and populate them with data before the query will run. This can be a significant hurdle, especially to casual BI users.

### User Experience Tip 3.1: Variable Naming Conventions

To address this issue, make sure variable descriptions clearly and consistently identify which variables are optional and which are mandatory. One way is to label all mandatory fields with the suffix (Required) — the term “Mandatory” can seem a bit severe — while leaving optional fields without a suffix. You can add (Optional) as a suffix to optional variables if you wish, but it seems redundant. If you have occasion to use variables with the Mandatory (Initial Value Not Allowed) setting, you can use a slightly different suffix such as (Value Required). It is also helpful to group all required variables at the top of the variable screen, especially if they do not have default values.

### User Experience Tip 3.2: Bypassing the Variable Screen

Once you have consistent variable naming conventions, you should closely examine whether it is necessary to have the variable screen appear before the query is run. Some user populations prefer jumping right into the query itself instead of being forced to fill out a preliminary screen. In order for this to be a viable option you must have proper query optimization procedures in place (query performance is covered later in the book), and it is also important to have clearly available interface elements to allow users to set up their own restrictions (also covered later in the book).

It is simple to allow users to bypass the initial variable screen: simply assign a default value to all required variables, or make your required variables into optional ones. The idea behind this Best Practice is to better control the user’s first impression of your query: because the SAP variable screen allows for relatively limited customization, many users will be better served by starting off with the rich interface options available through Web application designer (WAD) (covered in a later chapter).

The variable screen will still be available to users even if it is not displayed before the query runs — an easily accessible interface element allowing the user to display the variable screen is more important in this case.

In Figure 3.4, you can see at a glance that the first two variables are required, and the second two are optional. Because only one of the two required variables is populated, the query will not run until the user enters a Business Area.
3.3.2 Manual Input Flexibility

There are five basic types of variables that take manual input from users, each with a different degree of flexibility for entering values:

- **Single Value**: Users can enter a maximum of one value.
- **Multiple Single Values**: Users can enter any number of individual values or hierarchy nodes, one at a time. Exclusions are not allowed.
- **Interval**: Allows a “from” and “to” value to create a single range of values. Both a “from” and “to” value must be entered, and “between” is the only logical operator allowed.
- **Selection Option**: Allows the user to enter any number of single values, ranges, logical operators (greater than, less than, etc.), exclusions, and pattern matching. This is the most flexible type of variable, but you cannot combine a selection option variable with a hard-coded restriction.
- **Precalculated Value Set**: allows you to select a precalculated value set that has already been created using the BEx Broadcaster tool (covered later in the book), essentially using the output of another query as the input to the variable in this query.

Figure 3.4 shows an example of how these different variable types look after they are filled out. In BW 7, the only way to distinguish between these variable types is to click the box on the right side of the variable, bringing up a Select Value screen. The Select Value screen will automatically provide the appropriate functionality based on the type of variable. Because some values are already populated in Figure 3.4, you can see that the Individual Cost Centers variable is a selection option, as it contains a single value (10100), a range (20000 - 25000), and an exclusion (!20100).

In older versions of BW, the visual differences between these variable types were readily apparent on the variable screen itself. This often led to intimidating variable screens when several selection option variables were included, as more interface elements were included directly on the variable screen. Since BW 7 moved this functionality into the Select Value screen, the variable screen itself is somewhat simpler, but it is still important to choose the type of variable carefully. It may be tempting to just make every variable a Selection Option, but this may not make sense in all cases — for example, when using a variable associated with a hierarchy, Single Value or Multiple Single Value is probably a better choice. The
Select Value screen for Selection Option variables is also the most complex, which can negatively impact end user productivity, especially among casual users.

Another setting that impacts manual input variables is the Ready for Input option. When this option is checked (the default setting), the variable will appear in the variable screen. If it is unchecked, the variable will not be displayed in the variable screen and it cannot be changed by the user at query runtime, so the default value of the variable will be used. Be careful with this feature when using a required variable with no default value: if you uncheck Ready for Input for this variable, the query will never run, because there is no way for the user to enter the missing value.

Variables can be associated with characteristic values, hierarchies, text descriptions, or formulas. There are also different variable processing options: so far we have discussed only Manual Input variables. Replacement Path variables use the output of another query or characteristic variable as an automatic input into a text description or formula in the query. SAP provides a number of existing SAP Exit variables with delivered business content — these variables use prewritten code to automatically populate data such as the current fiscal month. You also have the ability to write your own code to populate data using a Customer Exit variable. Finally, Authorization variables are automatically populated based on the end user’s level of authorization for that characteristic (maintained in Transaction RSSM).

### 3.3.3 Creating Your Own Manual Input Variables

Now that you have more background information about manual input variables, we can walk through the variable creation process. We’ll start by creating a variable based on the Business Area characteristic.

**Procedure 3.2: Query-Level Variable Characteristic Restriction**

1. Right-click the Business Area characteristic and select Restrict.
2. Locate any hard-coded value restrictions on the right side of the dialog box, and double-click each one to remove them.
3. Pull down the Show menu and select Variables.
4. Make sure Characteristic Value Variable is selected in the Type dropdown, then click the first icon next to the dropdown to create a new variable (to edit an existing variable, select the variable and click the second icon).
5. In the Change Variable screen (see Figure 3.5) enter a Description and Technical Name for your new variable. Keep User Experience Tip 3.1 (regarding variable naming conventions) in mind when entering your description, as it will be displayed on the variable screen — in this case, we’ll enter Business Area (Required) as a description.

![Change Variable Screen, General Tab](image)

6. Because this variable is associated with a characteristic, the Type of Variable cannot be changed from Characteristic Value. The processing type for this variable will remain Manual Input.

7. Click the DETAILS tab to view more settings (see Figure 3.6). This is where we can change the manual input flexibility options discussed in the previous section, we’ll stick with SINGLE VALUE for this variable.

8. The second dropdown under the DETAILS tab controls whether or not the user is required to enter a value: change this dropdown from OPTIONAL to Mandatory.

9. Click the DEFAULT VALUES tab. For now, we will leave the default value for this variable blank, but click the Change Default Values button and note how you are only allowed to select a single Business Area; click cancel to back out of the default value selection. This behavior is controlled by the SINGLE VALUE option selected in step 6.
10. Make sure Variable is Ready for Input is checked — if it's unchecked, the variable will not appear in the variable screen.

11. Click the OK button, confirm the Description and Technical Name, then click OK again.

12. The new variable will appear on the left side of the characteristic Select Values screen, double-click the new variable to move it over to the right side, then click OK.

You will now see the variable appear under the characteristic in the query; you may have to click the plus sign next to the characteristic to see it. Note that because this variable is mandatory and has no default value, the variable screen will appear and the user must enter a Business Area before the query can be run.

**Exercise 3.1: Reproduce the Sample Variable Screen in Figure 3.4**

As an exercise, try reproducing the sample variable screen in Figure 3.4. You’ll need to add the cost center, company code, and fiscal year characteristics to the query under either Characteristic Restrictions or Default Values. Then, you’ll create an optional selection options variable for cost center, an optional multiple single values variable for company code, and a required interval variable for fiscal year with default values of 2009 - 2010.

You can run the query by clicking the Execute button (the fifth icon in the Query Designer toolbar) — the variable screen will appear, but the query will not contain any data because we haven’t set up the key figures yet.
User Experience Tip 3.3: Sorting Variables on the Variable Screen

One way to make the variable screen less daunting for casual users is to organize it using criteria that make sense for your business. A common practice is to list required variables first, especially required variables without default values. You can further sort variables by grouping them by function, such as including all of the variables for organizational unit characteristics together (i.e., business area, company code, cost center), followed by a group of time characteristics such as fiscal year and posting period.

To change the order of variables on the variable screen, click the Query menu at the top of the Query Designer window, and select Properties. On the right side of the window under the Properties pane, click the Variable Sequence tab. On this tab, you can select individual variables and click the up or down arrows to arrange them.

If you haven’t done so already, you may want to save your query. Click the disk icon (the third icon in the toolbar) on the main Query Designer screen, assign the query a technical name and description, and click OK to save the query in your Favorites.

3.3.4 Hierarchies and Hierarchy Variables

It is common for SAP implementations to utilize hierarchies as a means of organizing certain master data characteristics into a hierarchical format. The creation and maintenance of master data hierarchies is beyond the scope of this book, but we will examine how hierarchies are utilized in Query Designer, including hard-coded hierarchy restrictions, variables for both hierarchy nodes, and variables for hierarchies themselves.

Because hierarchies are often built for Cost Centers, we will use the Cost Center characteristic as an example for how to include hard-coded restrictions based on hierarchies. There are two settings relating to hierarchies we need to be concerned with: the hierarchy used for the hard-coded restriction, and the hierarchy used for the characteristic itself. We’ll start by setting up the restriction.

Procedure 3.3: Query-Level Fixed Restriction Based on Hierarchy

1. If you haven’t already done so, add the Cost Center characteristic to either Characteristic Restrictions or Default Values in Query Designer.
2. Right-click Cost Center and select Restrict.
3. Change the Show dropdown menu to Single Values.
4. Change the Hierarchy dropdown menu to reflect a cost center hierarchy you have already created. You can click the Wrench icon in the top right to show technical names if necessary.

5. The hierarchy itself will appear in the left-hand pane. Expand the hierarchy and add any number of hierarchy nodes to the right side by double-clicking the nodes or selecting them and clicking the right arrow.

6. If you've already added the Individual Cost Centers selection option variable from a previous section, remove it by double-clicking the variable from the right side.

7. Click OK.

You have now created hard-coded restrictions for hierarchy nodes based on the hierarchy you selected. Note that step 6 was necessary because selection option variables cannot be combined with a hard-coded restriction in the same characteristic. The next step is to assign a display hierarchy to the characteristic itself.

Procedure 3.4: Assign Display Hierarchy to Characteristic
1. Click Cost Center in the Query Designer screen once.

2. Look at the far right of the Query Designer screen and confirm that the properties for Cost Center are displayed (see Figure 3.7).

3. Click the Hierarchy tab.

4. Near the top of the Hierarchy tab, you will see Press Button for Hierarchy Selection under the Selected Hierarchy heading. Follow this advice and click the button on the right side of this field.

5. Make sure Hierarchy Name is selected, click the dropdown list, and select a hierarchy.

6. Click OK, and note that the Activate Hierarchy Display checkbox is automatically checked. The icon for Cost Center in Query Designer will also change to reflect the hierarchy assignment.

7. Adjust any additional hierarchy parameters as needed, such as the default expansion level or sorting options (see Section 3.5.2, Characteristic Properties, for more information).

The display hierarchy assigned to the characteristic is often the same hierarchy used to set up the hard-coded restriction, but the two can be different if necessary.
You may have noticed in step 5 that you have the option of setting up a Hierarchy Variable — this type of variable allows a user to choose which display hierarchy to use for a characteristic at query runtime. To create a Hierarchy Variable, continue from step 5, but instead of selecting a hierarchy, click the Hierarchy Variables radio button and click the button on the right of the field. Click the Create New Variable button in the resulting dialog box, and step through the variable creation process from Section 3.3.3, Creating Your Own Manual Input Variables. Hierarchy Variables must be single value, but they can be optional or mandatory. They can also be assigned a default value. Note that a characteristic with a Hierarchy Variable must appear in the Default Values pane of the Filter tab in Query Designer; if it is in the Characteristic Restrictions section, the user will not be prompted to select a hierarchy.

In addition to a variable that prompts the user to select which hierarchy will be displayed, you can also create variables that allow the user to add restrictions based on the structure within a hierarchy. The procedure to add a hierarchy node variable follows.

**Procedure 3.5: Query-Level Variable Restriction Based on Hierarchy**

1. If you haven’t already done so, add the Cost Center characteristic to either Characteristic Restrictions or Default Values in Query Designer.
2. Right-click Cost Center and select Restrict.
3. Remove any existing variables or hard-coded values from the right side by double-clicking them.

4. Change the Show dropdown menu to Variables.

5. Change the Type dropdown menu to Hierarchy Node Variables.

6. At the bottom of the screen, find the Variable Hierarchy section, and click the box to the right of the field to select which hierarchy to use for your new variable. You can either hard-code a specific hierarchy, or use a hierarchy variable so the user can select both which hierarchy to use for the restriction and which nodes in the hierarchy to restrict on.

7. Click the first button next to the Type dropdown menu to create a new variable based on the hierarchy you selected in the previous step.

8. Enter a description and technical name. You may wish to include the word “Hierarchy” or “Node” in the description to distinguish this variable from a nonhierarchy variable.

9. Click the Details tab for additional settings.

10. Choose whether to allow the user to enter only one hierarchy node (single value) or multiple hierarchy nodes (multiple single values).

11. Choose whether to make the variable mandatory or optional.

12. Click the Default Values tab and select a default hierarchy node, if needed.

13. Click OK and save the variable.

14. Drag the new variable over to the right pane and click OK.

In the main Query Designer screen, you will see the new variable under the Cost Center characteristic, and it will have the traditional Variable icon along with the Hierarchy icon to indicate that it is a hierarchy node variable.

### 3.4 Building a Query Layout

We will now shift gears from setting up restrictions with hard-coded values and dynamic variables to putting together a query layout to display data in rows and columns. The tools to build layouts can be found on the Rows/Columns tab of Query Designer.
3.4.1 An Overview of the Rows/Columns Tab

There are four sections within the Rows/Columns tab in Query Designer. The Free Characteristics section contains characteristics that are not displayed in the initial query layout, but can be displayed by the user at query runtime by utilizing the drilldown or drill across functionality. The Rows and Columns sections represent the initial view of the query, and items added to these two sections are displayed on the left side or the top of the query, respectively. While Free Characteristics can only contain individual characteristics, the Rows and Columns sections can contain individual characteristics or a Structure consisting of one or more Selections or Formulas. The last section is a Preview of what the query will look like.

You can add characteristics to Free Characteristics, Rows, or Columns the same way they are added to the Characteristic Restrictions or Default Values sections from the Filter tab: by dragging the characteristics from the InfoProvider pane. If a characteristic is added to the Free Characteristics section, it will not be displayed in the query's initial view, but it will be available to the user under the Free Characteristics section of the query navigation area. If it is added to the Rows section, the characteristic will be displayed on the left side of the query in the initial view, and any characteristic added to Columns is shown at the top of the query's initial view.

3.4.2 Creating a Simple Structure

While it is possible to create a query with only characteristics in Rows and Columns, such a query would only be able to show master data. To show transaction data (from Key Figures), a Structure must be created. There are two types of structures: a Key Figure Structure is, surprisingly enough, a structure that contains key figures. The other type of structure, a Characteristic Structure, cannot contain key figures. A query can have a maximum of two structures, only one of which can be a Key Figure Structure.

But what exactly is a structure? The (relatively) short answer: a structure is a collection of Selections — items containing one or more restrictions on characteristics or key figures — and Formulas, which can use a number of different operators to derive values from other query components. Structures provide an incredible amount of flexibility: the items we created earlier on the Filter tab provided query-level restrictions on characteristics, but each element of a structure can be set up to restrict data based on any number of characteristics at the individual line level.
Structures are very easy to create. In fact, if you drag a key figure from the Info-Provider tab to either the Rows or Columns pane, Query Designer will automatically create a new structure called Key Figures, containing a single key figure. This key figure is really a Selection that has not yet been set up with any characteristic restrictions. Because this new selection contains a key figure, the structure is now your query’s one and only Key Figure Structure. Let’s create a Key Figure Structure with a few selections for a simple financial report that shows actual and plan transaction data.

**Procedure 3.6: Create Selections with Fixed Restrictions**

1. Expand Key Figures in the InfoProvider pane on the left, and drag the Amount key figure to the Columns pane on the right. A new structure called Key Figures will be created, with a new selection containing Amount.
2. Double-click the Amount selection under the Key Figures structure to open the Change Selection window (see Figure 3.8).
3. Change the Description at the top to read “Actual.”
4. Expand Dimensions on the left side of the window. In SAP, actual and plan transaction data are typically segregated by Value Type. Find Value Type under the relevant InfoProvider dimension and drag it over to the right side. For now, do not expand Value Type in the list on the left side.
5. Right-click Value Type on the right side pane and click Restrict.
6. Move Actual from the left side to the right side by either double-clicking it or selecting it and clicking the right arrow button, then click OK.
7. Click OK one more time to save the current selection.
8. Now that we have created the Actual selection, we can move on to the Plan selection. Right-click the Key Figures structure in the Columns pane and click New Selection.
9. A new empty selection will be created. Double-click this new selection to open the Change Selection screen.
10. Change the description to Plan.
11. Because you created this empty selection from scratch, you’ll need to manually add the Amount key figure. Locate it on the left side under Key Figures and drag it to the right pane.
12. This time we’ll use a shortcut to add the Value Type restriction. Locate Value Type under Dimensions on the left side pane, and click the plus sign next to Value Type to expand it.

13. Click the plus sign next to Characteristic Values to show all of the potential values for Value Type.

14. Drag Plan from the left side pane to the right side pane. Value Type will automatically be created on the right side with Plan as a restriction.

15. Click OK to return to the main Query Designer screen.

You will now see two selections under the Key Figures structure: Plan and Actual. If you’d rather have Actual first, you can drag the Actual selection up until you see a black line between Key Figures and Plan. Be careful not to release the mouse button if the Plan selection is highlighted, otherwise you will end up with nested selections — hierarchical views within structures will be covered later in the book.
Now that we have two selections, we can create a Formula that calculates a new value using these two selections. A commonly used calculation is a variance, which is Plan — Actual. Let’s go ahead and create a formula for variance.

**Procedure 3.7: Create a Simple Formula Using Existing Selections**

1. Right-click the Key Figures structure in the Columns pane and click New Formula.
2. A new empty formula will be created. Double-click this new formula to open the CHANGE FORMULA screen (see Figure 3.9).
3. Delete the existing DESCRIPTION at the top. Type “Variance,” press [Enter], and type “(Plan – Actual).” This will create a two-line column header in the query view.
4. In the AVAILABLE OPERANDS pane at the bottom left of the screen, expand KEY FIGURES and double-click PLAN. This will insert the Plan selection into the DETAIL VIEW section of the screen.

![Figure 3.9 Change Formula Screen](image)
5. A number of operators are available at the bottom right of the screen, but basic mathematical functions are found in a toolbar just above Available Operands. Locate this toolbar and click the minus sign (-).

6. Double-click Actual under the Available Operands pane.

7. The Detail View section should now read Plan — Actual. Click the OK button to return to the main Query Designer screen.

You will now see Variance (Plan – Actual) as the first entry under the Key Figures structure. To move this formula to the end, drag it down until you see a black line under Plan. Again, ensure that Plan is not highlighted when you release the mouse button.

User Experience Tip 3.4: Explain Formulas in Column Headers

It is a good practice to explain your formulas directly in column headers whenever possible, especially for casual users. Obviously, a complex formula may not be easily summarized, and you should be mindful of column widths, but if it's possible to clarify the gist of a formula with a few extra words, that's well worth the extra use of screen real estate.

This tip is of particular value when a specific term has different meanings to different people in your organization. For example, some groups may use a Plan – Actual calculation for Variance, while others may use Actual – Plan.

You can go back and edit existing selections or formulas at any time, and selections may contain any number of characteristic restrictions. It is common for plan data to be further segregated into different plan versions using the Version characteristic, so let’s revisit the Plan selection and add a new restriction for Version. While we’re at it, let’s allow the user to select which version they want to see by using a variable instead of a hard-coded restriction.

Procedure 3.8: Including Line-Level Variable Restrictions in a Selection

1. Double-click the Plan selection under the Key Figure structure in Columns to show the Change Selection screen.

2. Locate Version under the relevant dimension on the left side and drag it to the right side of the window.

3. Double-click Version from the right side of the window.

4. Click the Show dropdown at the top and select Variables.
5. If you have a Version variable already created (or activated from business content), drag it over to the right side. If not, click the Create New Variable button and step through the process of creating a new version variable, ideally mandatory and single value.

6. Click OK to return to the Change Selection screen.

7. Confirm that the new variable appears correctly under Version, and click OK.

The user will now be prompted to select a plan version at the variable screen before running the query. If we had not included this variable (or a hard-coded restriction), and data existed on your InfoProvider under multiple versions, the Plan column would have shown a sum of all of those versions, which is probably not what your users want to see. It is critical to carefully examine the data in your InfoProviders to ensure you have the correct restrictions on your key figures.

Now that we have a simple structure in place, let’s start adding tools to allow users to analyze the data at higher levels of detail.

### 3.4.3 Adding Characteristics as Drilldowns

The real power of an analytical reporting system comes from the ability to easily drill down into data with increasingly finer granularity. Query Designer provides this functionality with the Free Characteristics, Rows, and Columns panes, as discussed earlier in this chapter.

If you check the Preview pane in Query Designer, you will see that the query created in the previous section consists of one row with three columns. Because we have not provided any options for drilling down on characteristics, the data shown will be at the highest level possible — the only restrictions other than those in the Key Figures structure are at the query level, based on those created earlier in the Characteristic Restrictions and Default Values sections. Let’s remedy this situation by adding a few characteristics to the Rows and Columns so they display in the initial query view.

Looking at a financial report as an example, it is common to show higher-level characteristics broken down by lower-level (more detailed) characteristics as “drilldowns.” Let’s add Company Code, a high-level characteristic, to the Rows column by dragging it over from the InfoProvider pane. Unlike items within a structure, you cannot add restrictions to individual characteristics here; the only options are adding query-level restrictions in Characteristic Restrictions or Default Values.
under the Filter tab, or creating a structure and adding line-level restrictions within a selection.

Now let's add Cost Center to the Rows section by dragging it from the InfoProvider pane. Make sure to drop Cost Center under the existing Company Code characteristic. Checking the Preview pane, we can see that this query will now show Actual, Plan, and Variance data broken down by company code first, then by cost center.

If you'd like to add a characteristic's display attributes, you can do so by expanding the characteristic on the InfoProvider pane and expanding the Attributes folder. All of the characteristic's display attributes will be listed, and you can drag them over to the characteristic on the right side. The attribute will appear under the characteristic. If you try to drag an attribute to the right side without first adding the characteristic, Query Designer will automatically include the characteristic.

It is also common to add a timeframe drilldown to the query — without such a drilldown, the query will show the sum of all data populated in the InfoProvider from the current year, future years (for plan data), and past years, based on query-level timeframe restrictions. Time characteristics are often added to the Columns section of the query, so let's drag Fiscal Year from the InfoProvider pane over to the Columns section, and drop it in the small space between the Columns header and the Key Figures structure. Technically, this is considered a “drill across” because the characteristic is in the columns of the query, but I prefer using the terms “drilldown” or “breakout.” When it is necessary to distinguish them, you can add “in the rows” or “in the columns” to either term.

As you can see from the Preview pane, the top of the query will show a breakout of fiscal years, followed by the Actual, Plan, and Variance values for each year. In terms of the end user's view of the query, the structure is treated as just another characteristic.

Recall that restrictions cannot be added to individual characteristics in the Rows/Columns tab of Query Designer. If you completed Exercise 3.1 earlier in the chapter, you already have a Fiscal Year Range variable attached to the Fiscal Year characteristic at a query level, meaning that the user will be prompted to select a range of years to restrict data for the entire query. You can click the Filter tab at the bottom to see this variable; it will appear under Fiscal Year in either Characteristic Restrictions or Default Values. When you add a characteristic anywhere in the Rows/Columns tab, it will automatically add an entry for the characteristic under Default Values in the Filters tab. This entry will initially be empty, but you can add hard-coded restrictions, add a variable, or leave it without any restrictions.
We've added entries into the Rows and Columns, so let's add a few characteristics to the Free Characteristics pane. Look in the InfoProvider pane on the left side of the Query Designer window, and drag Business Area, Cost Element, and Posting Period to Free Characteristics. Notice that the Preview section does not change, as the items in Free Characteristics are not displayed in the initial query view, but users have the option of adding these characteristics to either the rows or the columns ("drilling down") at query runtime.

The Rows/Columns tab of the Query Designer screen should now look something like Figure 3.10. Now that we have a more filled-out query, let's return to the Key Figures structure to examine how text variables can be used to dynamically label components of a structure.

**Figure 3.10** Query Designer Screen with a Simple Structure

### 3.4.4 Dynamic Labeling with Text Variables

Looking back at the Plan selection we created in the last section, you'll notice that the contents of the selection will change depending on which plan version the user selects when they run the query. However, the current description of the selection does not tell the user which plan version is being displayed. Luckily, this is easily remedied by using a text variable. Let's create a text variable that displays the contents of the Version variable.
**Procedure 3.9: Create a New Text Variable**

1. From the Rows/Columns tab, locate the Key Figures structure under Columns and double-click Plan.
2. Click once in the Description field after Plan, and hit enter to create a new line.
3. Click the dropdown next to the Variables icon to right of the description field, and select New Variable.
4. We will now create a Replacement Path text variable that will display the contents of the Version attribute. On the General tab, enter a technical name and a relevant description such as “Version – Key.” Although the end user will never see this description, it will still be useful to anyone who utilizes this variable in the future.
5. Click the Processing By dropdown and select Replacement Path.
6. A new dropdown labeled Reference Characteristic will appear: this is where the text variable will get its displayed value from. Select Version from this list.
7. Click the Replacement Path tab, and make sure the Replace Variable With dropdown has InfoObject selected. You can also replace the text variable with the value from another variable, but we’ll stick with InfoObject for now.
8. There are several options in the Replace With dropdown. We’ll go over these options later, for now select Key.
9. The Use Interval option lets you select the first value in a range, the last value, or the difference between the two. Because Version is not a range in this case, we will leave From Value selected.
10. The Offset Setting is not useful in this situation, so we’ll leave it empty. This setting is discussed in more detail later.
11. Click the OK button to create the text variable.

The new text variable will now appear on the second line of the Description field, displayed as the technical name of the variable with ampersands on either side, like this: &ZVARNAME&. In the future, you can add this text variable to other descriptions of structure components by clicking the dropdown next to the Variables button on the right side of the description field and clicking Entry of Variables, or just clicking on the Variables button itself.
Because we selected Key in step 8 earlier, the user will see the key value associated with the selected version under Plan in the column header. Other options include the external key value or the text description (Label in the Replace With dropdown). You can also select an attribute value (another dropdown appears to select which attribute of the characteristic to use, if any) or a hierarchy attribute, but these two options are only useful in formula variables, which are discussed later.

A common use of text variables is to indicate which timeframe is being viewed when timeframe selections are dynamic. Our next exercise will involve removing our existing query-level fiscal year variable restriction and adding a line-level restriction into the Key Figures structure. We will then add appropriate text variables to indicate which year is being displayed. We will also use this opportunity to look at the time-oriented variables SAP provides with business content, and variable offset functionality.

Procedure 3.10: Applying an SAP Exit Variable and Text Variable to a Selection (Fiscal Year)

1. To remove the query-level fiscal year variable restriction, switch to the Filter tab at the bottom of Query Designer, expand Fiscal Year, right-click on the variable you created, and select Remove. You can also left-click the variable and press the Delete key on your keyboard.

2. Switch back to the Rows/Columns tab.

3. Because we will be filtering on Fiscal Year within the Key Figures structure, there's no need for a separate Fiscal Year drilldown. Right-click Fiscal Year in the Columns and select Remove.

4. Double-click the Actual selection under the Key Figures structure.

5. Look on the left side of the window under Dimensions, locate Fiscal Year, and drag it to the right side.

6. Right-click Fiscal Year on the right side and select Restrict.

7. Change the Show dropdown box to Variables.

8. If you've activated the necessary business content, you will see a number of existing variables here. Look for Current Fiscal Year (SAP Exit) [OFYEAR]. This variable is provided by SAP and automatically returns the current fiscal year. You can select this variable and click the Edit Variable button at the top to examine the variable settings: notice that on the General tab the Processing By setting is SAP exit, and on the Details tab the Ready for Input box is
not checked, meaning that the user will not be able to change the value of the
variable at query runtime.

9. Drag this variable over to the right side of the screen and click OK. Notice
that the Current Fiscal Year variable now appears under Fiscal Year.

10. Click in the Description field at the top left, just after the word Actual, press
\[Enter\], and click the Variable button to the right of the field.

11. Locate the SAP-provided text variable replaced by 0FISCYEAR
[0T_FYEAR] and double-click it. You will see &0T_FYEAR& on the second line
of the description.

12. Click OK to return to the Query Designer screen and confirm that the Actual
selection has changed to Actual &0T_FYEAR&.

When the query is run, the Fiscal Year characteristic will automatically be replaced
by the current year, and the description of the Actual column will display that year.
In order for a text variable to function correctly, it must refer to a single value. If
no value is found for the characteristic or if there are multiple single values, the
text variable will output its technical name instead of a value. For example, if we
set up a hard-coded restriction on fiscal year for the single values of 2009 and
2010, the name of the column will appear as Actual &0T_FYEAR&. However, if we
set up a value range restriction instead of multiple single values, the text variable
will show the first value in the range, the last value, or the difference between the
two, according to the settings in step 9 of Procedure 3.9.

Note that we’ve added the current fiscal year restriction to the Actual selection,
but not to Plan. To avoid the Plan column showing data from all fiscal years —
because we removed the query-level fiscal year variable restriction — we’ll need
to run through Procedure 3.10 one more time to apply the current fiscal year
variable and the text variable to the selection. The Plan selection already contains
a text variable, but a single selection can support any number of text variables,
again assuming each text variable references a characteristic with a unique value
in the query.

Let’s not forget about the Variance formula we created earlier — formulas can also
use text variables. Double-click Variance and add the fiscal year text variable to the
description. As a shortcut, if you already know the technical name of the text vari-
able (in this case, 0T_FYEAR) you can type it directly into the description field as
long as it is between two ampersands: &0T_FYEAR&. The name of the text variable
will be automatically highlighted as soon as you type the final ampersand.
User Experience Tip 3.5: Automatically Populate Current Year or Not?

Even though SAP provides an exit variable that automatically populates the current year, you may find that it makes more sense for your users if the current year is not automatically populated, especially at the beginning of the new year (calendar year or fiscal year). If you create a variable for calendar year or fiscal year on your own, you would have to manually maintain the default value, but you can choose when to change the default value to the current year. In our experience, for the first week or two of the year, most users would rather see the full prior year rather than the nearly empty current year. Later in the book, we will see additional options for creating more flexible timeframe selections that will help alleviate this issue.

Another useful setting involving text variables is the Offset Setting, found on the Replacement Path tab of the Change Variable screen. You can see this setting by editing an existing text variable: click on the text variable's technical name in the Description field of the Change Selection or Change Formula screen, then click the dropdown triangle next to the Variables icon to the right of the Description field and select Change Variable. The two entries under the Offset Setting section of the Replacement Path tab, Offset Start and Offset Length, control where the text variable starts displaying data and how many characters it displayed.

Let's use the Fiscal Year variable as an example. If the text variable is set up to show the External Characteristic Value Key of the Fiscal Year characteristic, and the Fiscal Year characteristic is compounded with Fiscal Year Variant, the text variable would display something like K4/2010, where K4 is the fiscal year variant. Because the end user probably isn't all that interested in the fiscal year variant, you'll want to set the Offset Start value at 3, so the text variable starts after the third character. The Offset Length would be 4 to display the four-digit year. Alternatively, if you wanted to display the two-digit year, the Offset Start would be 5 and the Offset Length would be 2.

3.4.5 Using Variable Offsets and Ranges

In some cases, you may want to have a column in your query to show current year data and a column that shows prior year data. While it is possible to implement this by creating a separate fiscal year variable for the prior year column, the second variable requires additional input from the end user. Luckily, SAP has provided a way to automatically offset the value of a variable within a specific selection. This is a separate concept from the text variable offset discussed before, as this variable...
offset affects that actual value of the variable. It also only works with variables based on time characteristics.

Let's set up a new selection in the Key Figures structure to show Actual data for the prior year, based on the fiscal year variable. Because this new selection will be very similar to the existing Actual selection, we can take a shortcut by copying and pasting: right-click the Actual selection in the Key Figures structure, click Copy, then right-click the Actual selection again and click Paste. This will insert a copy of the Actual selection just after the original. Alternatively, you can click an existing selection, press $\text{Ctrl} + \text{C}$ to copy the selection, and press $\text{Ctrl} + \text{V}$ to paste the copy. The new copies of the selection will have the same description, so if the original selection is included in a formula, be sure not to change the original. We will now set up the variable offset.

**Procedure 3.11: Offset the Value of an Existing Variable**

1. Double-click the new Actual selection under the Key Figures structure you just pasted to edit it. We will now change the fiscal year variable to show the prior year instead of the current year.
2. Right-click Fiscal Year and select Restrict to open the Select Values screen.
3. Confirm that there is already a fiscal year variable on the right side, and left-click the variable once to select it.
4. Click the – + icon (the third icon to the right of Chosen Selection at the top of the right side). This will open the Set Variable Offset window.
5. Because we are looking for the year prior to the one in the existing fiscal year variable, enter -1 in the Variable Offset Value field and click OK.
6. Confirm that the variable under Fiscal Year now has a -1 at the end of its description to indicate the offset.
7. If you wish, you can change the description to read “Prior Year Actual” or “PY Actual” followed by the text variable. Note that the text variable does not have to be changed, as it automatically uses the value in the variable after the offset has been applied.
8. Click OK to return to the Query Designer screen.

The new selection for prior year actual is now complete. Next, we'll look at an example that combines the concepts of text variables and variable offsets with value range restrictions: creating a new selection to show the previous three
months of actual data (not including the current month). To create this restriction, we'll need to use a new time characteristic: Fiscal Year/Period (OFISCPER).

**Procedure 3.12: Use Variable Offsets within a Value Range**

1. Copy and paste the existing Actual selection to create a new duplicate selection, and double-click the new selection.
2. Locate Fiscal Year/Period on the left side of the screen under the relevant dimension, and drag it to the right side.
3. Double-click Fiscal Year/Period on the right side.
4. Click the Show dropdown menu at the top and select Value Ranges.

We will now set up a range that restricts values from four months before the current month to the one immediately before the current month. For example, if the current month is July, this range will run from April through June.

1. Make sure Between is selected in the first dropdown box, and click the button next to the second dropdown box to open the Select Values screen for the From value of the range.
2. Click the Show menu and select Variables.
3. Find the variable Current Fiscal Year/Period (SAP Exit) [OFPER] in the list, click on it, and press OK. This variable is provided by SAP in business content, and it uses the Date_to_Period_Convert function module to return the current fiscal month and year.
4. Click the button next to the third dropdown box and repeat steps 6 and 7 above. The Current Fiscal Year/Period (SAP Exit) variable should now appear in both dropdown boxes on the left side.
5. Click the right arrow button to move this range over to the right side.
6. As it stands now, the range will only select the current month, as we have not entered offsets yet. To enter variable offsets, right-click the range on the right side and select Set Offset for Variable.
7. The Set Variable Offset dialog box will now appear twice in succession: the first box is for the “from” value, the second is for the “to” value. In the first box, enter -4 and click OK. Enter -1 in the second box, and click OK again.
8. Confirm that the right side of the screen now says CURRENT FISCAL YEAR/PERIOD (SAP EXIT) – 4 – CURRENT FISCAL YEAR PERIOD (SAP EXIT) – 1, as seen in Figure 3.11, and click OK to return to the Change Selection screen.
Because the new Fiscal Year/Period range already includes Fiscal Year as a restriction, let's remove the existing Fiscal Year entry from the right side of this selection by clicking Fiscal Year and pressing the Delete key on your keyboard. Leaving this additional restriction would cause issues near the beginning of the year: for example, in February 2010, the Fiscal Year/Period Range would include January 2010, December 2009, and November 2009. If this selection was restricted to only fiscal year 2010, data for the previous December and November would not appear, as selection restrictions are processed on an AND basis rather than OR.

**Figure 3.11** Fiscal Year/Period Value Range with Variables

This new selection will now automatically show the previous three months of actual data, not including the current month. You can label this selection something like “Actual - Trailing 3 Months,” but it’s more straightforward to include the actual months in the description. We can do this by using text variables SAP has included in business content.

**Procedure 3.13: Use Text Variables with a Variable Value Range**

1. In the Change Selection screen, delete the existing text variable in the Description field and position the cursor on the second line of the field.
2. Click the Variables icon to the right side of the Description field to add an existing text variable.
3. We will need two variables here: one to show the “from” value of the range, and one to show the “to” value. Luckily, SAP has provided variables for both. If technical names are not already shown, click the Wrench icon at the top right until they are displayed.
4. Locate Text Variable Replaced by 0FISCPER [OT_FPERF] in the list, click the variable once, then click the Edit Variable button at the top right. Click the Replacement Path tab and confirm that the Use Interval setting is From Value, then click OK.

5. Locate Text Variable Replaced by 0FISCPER [OT_FPERF] in the list again, click the variable once, and click OK. &0T_FPERF& should appear in the description under Actual.

6. Make sure the cursor is positioned just after the new text variable, type “to,” then click the variable icon on the right side of the Description field again.

7. Repeat steps 4 and 5 for Text Variable Replaced by 0FISCPER [OT_FPERT], this time confirming that the Use Interval setting is To Value. Once step 5 is complete, both text variables will appear in the selection description.

8. Make sure there is a space between “to” and both text variables, and click OK to return to the Query Designer screen.

When the query is run, this new selection will now display both the “from” and the “to” values of the fiscal year/period interval: for example, Actual 11/2009 to 01/2010. Once all of these changes have been made, the Rows/Columns tab of Query Designer should look something like Figure 3.12.

[Image: Query Designer Screen: Structure with Text Variables]
Next we will explore the different properties that can be set for the query as a whole, and for individual query components.

### 3.5 Properties for Queries and Query Components

The Properties pane on the right side of the Query Designer screen offers many options for customizing the behavior of your query. There are two ways to select an item so its properties are displayed: you can click on the item (or the area), or you can select from the dropdown box at the top of the pane. You can also \[\text{Shift}\] + click or \[\text{Ctrl}\] + click on multiple items in Query Designer to make contiguous or noncontiguous selections, respectively, allowing you to change properties on multiple items at once.

We'll start by examining the properties of the query itself: to see the query's properties, you can either select the first item in the dropdown box (containing the name or technical of the query), or click the Query menu and select Properties.

#### 3.5.1 Query Properties

There are seven tabs containing properties for the query as a whole; we'll start by examining the options on the General tab (see Table 3.1).

<table>
<thead>
<tr>
<th>Description</th>
<th>Name of the query as seen by end users, can include text variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Name</td>
<td>Unique identifier given to a query, cannot be changed after query creation</td>
</tr>
<tr>
<td>InfoProvider</td>
<td>Technical name of the InfoProvider the query is assigned to, cannot be changed after query creation</td>
</tr>
<tr>
<td>Key Date</td>
<td>Determines the date to use when reading time-dependent data, defaults to the current date, can be populated with a fixed value or a variable based on 0CALDAY</td>
</tr>
</tbody>
</table>

**Table 3.1** Properties of Query: General Tab

At the bottom of the General tab, the username of the person who created the query is shown, along with the username of the person who last modified the query and when they modified it.

The next tab, Variable Sequence, was discussed in Section 3.3.3. It can be used to modify the order of the variables as they appear on the variable screen.
The settings in the Display tab only affect output in BEx analyzer, the Excel interface for running queries (see Table 3.2). For queries run on the Web, the properties of the Analysis web item in WAD must be changed. Both BEx analyzer and WAD will be discussed later in the book.

| Table 3.2 | Properties of Query: Display Tab |

| Adjust Formatting after Refreshing | Checked by default, this setting will reapply formatting when refreshing a query within the BEx analyzer Excel interface. |
| Hide Repeated Key Values | Checked by default, this setting will only show the first value when multiple contiguous rows have the same value. See Figure 3.13 for an illustration. |
| Display Scaling Factors for Key Figures | When checked, this setting displays an additional line in the query output below each column heading indicating the scaling factor for that column. Scaling factor is set in the properties of Key Figure structure components. |
| Document Links | These three checkboxes control the display of three different types of BI documents. InfoProvider Data documents are displayed on individual cells, and are used to comment on transaction data, i.e., actual dollars spent for a specific cost center during a certain month. Master Data documents are attached to characteristics such as business area or plan version. Metadata documents are at the query level. BI documents are discussed in more detail later in the book. |

<table>
<thead>
<tr>
<th>Hide Repeated Key Values: Checked</th>
<th>Hide Repeated Key Values: Unchecked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost Center</td>
<td>Cost Element</td>
</tr>
<tr>
<td>100</td>
<td>500</td>
</tr>
<tr>
<td>100</td>
<td>510</td>
</tr>
<tr>
<td>100</td>
<td>600</td>
</tr>
<tr>
<td>100</td>
<td>630</td>
</tr>
<tr>
<td>101</td>
<td>500</td>
</tr>
<tr>
<td>102</td>
<td>600</td>
</tr>
<tr>
<td>102</td>
<td>630</td>
</tr>
<tr>
<td>103</td>
<td>610</td>
</tr>
<tr>
<td>103</td>
<td>600</td>
</tr>
<tr>
<td>103</td>
<td>650</td>
</tr>
</tbody>
</table>

**Figure 3.13** Hide Repeated Key Values Setting
Unlike the Display tab, the rest of the tabs affect query output via both the BEx analyzer Excel interface and queries run on the Web. The Rows/Columns tab includes a preview at the bottom of the window to show the impact of changing settings (see Table 3.3).

| Result Position: Rows, Columns | Controls where summarized results rows and columns (typically highlighted in yellow) appear in the query: either above or below existing rows, and to the left or right of existing columns. Default settings show results at the bottom right of existing data. |
| Suppress Zeros | The default setting, Do Not Suppress, shows all data in the query, even if the data in a row or column is all zero. Changing this setting to Active will hide a row or column if its total adds up to zero, even if individual cells in the row or column are nonzero. The Active (All Values = 0) setting will only hide a row or column if all of the data in the row or column is zero. See User Experience Tip 3.5 for more information. |
| Effect on | Controls how zero suppression is applied: either only on rows, only on columns, or both rows and columns. For example, if you always want the same set of columns shown, even if one or more of the columns contains no data, you’ll want to either disable zero suppression entirely (using the previous setting) or apply the suppression to rows only. |

Table 3.3 Properties of Query: Rows/Columns Tab

User Experience Tip 3.6: Watch Out for Active Zero Suppression

Be very careful when using the Active setting for Suppress Zeros, especially when dealing with financial reports with month-by-month breakdowns. For example, offsetting postings may occur within a cost center during the year. If the total for the year adds up to zero and Suppress Zeros is set to Active, that line of data may disappear from the query, depending on which characteristics are active drilldowns. It is safer to use the Active (All Values = 0) setting, which will still show the line containing offsetting postings, even if the total is zero.
Properties for Queries and Query Components

3.5 Display of +/- Signs

Allows you to change how negative values are displayed, with a minus sign before the number, a minus sign after the number, or the number in parentheses.

Zero Value Display

Not to be confused with Suppress Zeros, this option controls how cells with a value of zero are displayed in the query. Zero values can be shown with the currency or unit (for example, 0 HRS or EUR 0.00), without the currency/unit, as an empty cell, or as a text string.

Table 3.4 Properties of Query: Value Display Tab

The Value Display tab, shown after the Rows/Columns tab, contains settings that can change how negative and zero values are displayed. The next tab, Planning, contains a single checkbox that controls whether or not a query starts in “change mode.” This setting is only active for input-ready queries created for BI Integrated Planning.

Finally, the Advanced tab has an option that enables external reporting tools to access the query via the Object Linking and Embedding Database (OLE DB) for Online Analytical Processing (OLAP) interface.

This concludes the properties available for the query as a whole. If you click the dropdown box at the top of the Properties pane, you will see a hierarchy of all of the query components, many of which have their own properties. We’ll examine characteristic properties next: expand SHEET (Page), then Rows (Area), and click Cost Center.

3.5.2 Characteristic Properties

Each characteristic has five tabs of settings in its Properties pane. Looking at the General tab for the Cost Center characteristic, you can see the same Description and Technical Name fields available in the query properties section. Changing the description of a characteristic here in the query may come in handy if different user populations have different names for a specific characteristic.

Next, we’ll take a look at the Display tab, which contains a number of useful settings for changing how characteristic values appear in the query (see Table 3.5). For these settings, you have the option to check the Use Characteristic Setting checkbox, which will use the settings maintained in the RSD1 maintenance screen for the relevant InfoObject.
Value Display: Display As

Controls how the characteristic value is displayed: you can show only the key value, only the text value, or both the key and the text (the latter options are only available if text values are maintained for the characteristic). You can also choose No Display to hide the characteristic value — for example, if you have Currency as an active drilldown, displaying the characteristic value may be redundant if the currency is already shown on the key figure.

Text View

If you are showing the text value of the characteristic, this option allows you to show Standard text (default value, uses shortest available text), short text, medium text, or long text. Only text lengths that have been maintained in the characteristic are available on this menu.

Sorting: Sort Characteristic

Allows you to sort the characteristic values displayed in the query. The default value uses the order specified in the query definition, sorting by characteristic key if no order specified. Other options include sorting by the values of the characteristic itself, or by an attribute of the characteristic.

Sort by/Sort Direction

Control whether to use the key or text value of the characteristic or attribute, and whether to sort ascending or descending.

Results Rows

There are three options for displaying results rows. The Always Display option will show a results row after each characteristic value displayed in the query, even if there is only one row for that value. Display If More Than One Value will not show a results row if there is only one row for a characteristic value, but it will display the results row for multiple values. The Always Suppress option will never show a results row.

Table 3.5 Properties of Characteristic: Display Tab

User Experience Tip 3.7: Results Row Overload

Superfluous results rows can be distracting, so pay close attention to the Results Rows setting for each characteristic, even those that are not drilled down by default. The Always Display option in particular can potentially lead to the display of non-value-added information. Enabling zero suppression in the query can also lead to the unexpected display of results rows when the Display If More Than One Value option is selected.
We’ve already introduced the Hierarchy tab in Section 3.3.4, Hierarchies and Hierarchy Variables, when going over the procedure for assigning a display hierarchy to a characteristic, but there are a few additional options on this tab (see Table 3.6). As with the Display tab, you have the option here to use default values maintained in the RSD1 InfoObject maintenance screen by checking the Use Hierarchy Setting checkboxes.

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Activate Hierarchy Display</strong></td>
<td>Toggles between displaying the characteristic values according to the display hierarchy selected and displaying the values as a flat list. Grayed out if no display hierarchy is selected.</td>
</tr>
<tr>
<td><strong>Selected Hierarchy</strong></td>
<td>Selects a display hierarchy for the characteristic. See Procedure 3.4 in Section 3.3.4 for instructions on how to select a display hierarchy.</td>
</tr>
<tr>
<td><strong>Expand to Level</strong></td>
<td>Controls the level the hierarchy will display by default when the characteristic is an active drilldown.</td>
</tr>
<tr>
<td><strong>Position of Lower-Level Nodes</strong></td>
<td>You can choose whether to show child nodes above or below their parent node. The default setting is “below,” which will show the highest level node at the top or left and the overall result at the bottom or right. The “above” setting flips this around.</td>
</tr>
<tr>
<td><strong>Values of Posted Nodes</strong></td>
<td>Controls whether values posted to a hierarchy node are displayed or hidden. Values posted to a node are displayed as an additional entry directly under the node, while the node itself continues to display the aggregated total of all child nodes (including the value posted to the node).</td>
</tr>
<tr>
<td><strong>Nodes with Only One Lover-Level Node</strong></td>
<td>This setting allows you to hide hierarchy nodes that only have a single child node, to avoid cluttering up the query with potentially non-value-added information. See Figure 3.14 for an illustration. If a node with only a single child node is already collapsed, when expanded it will be replaced with the next child node that contains multiple values. For example, let’s say this option is set to HIDE and the HIERARCHY TOP node in Figure 3.14 is collapsed by default. When the user expands this node, it will automatically be replaced by the THIRD LEVEL A node.</td>
</tr>
<tr>
<td><strong>Sorting</strong></td>
<td>Controls whether the order of the values in the hierarchy is according to the order defined in the hierarchy itself (the default value), or by the characteristic value’s key or text.</td>
</tr>
</tbody>
</table>

Table 3.6 Properties of Characteristic: Hierarchy Tab
Nodes with Only One Lower-Level Value:

<table>
<thead>
<tr>
<th>Always Show</th>
<th>Nodes with Only One Lower-Level Value:</th>
</tr>
</thead>
<tbody>
<tr>
<td>▼ Hierarchy Top</td>
<td>▼ Third Level A</td>
</tr>
<tr>
<td>▼ Second Level A</td>
<td>Posted Value 1</td>
</tr>
<tr>
<td>▼ Third Level A</td>
<td>Posted Value 2</td>
</tr>
<tr>
<td>Posted Value 1</td>
<td></td>
</tr>
<tr>
<td>Posted Value 2</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 3.14** Nodes with Only One Lower-Level Value

The next tab, Planning, contains settings that are only valid for queries built for the BI Integrated Planning component. However, the Advanced tab contains a few interesting options (see Table 3.7).

<table>
<thead>
<tr>
<th>Access Type for Result Values</th>
<th>Allows you to choose how you want characteristic values displayed in the query. If you select Posted Values, the default setting, characteristic values will only appear in the query if there is corresponding transaction data. The Characteristic Relationships option will display data if a relevant characteristic relationship has been created in the BI Integrated Planning module. Finally, choose Master Data if you want all values for this characteristic to be displayed, even values without posted transaction data.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter Value Selection During Query Execution</td>
<td>When a user filters on a characteristic, this setting controls the values displayed in the filter list. The Only Posted Values in Navigation setting will only display the values shown based on existing query filters and variable selections. You can also set the filter box to only display values contained in the InfoProvider, display all values in the master data table, or restrict data based on characteristic relationships from BI Integrated Planning.</td>
</tr>
<tr>
<td>Refresh Variables</td>
<td>A recent addition to the Advanced tab, this setting is useful if an exit variable associated with this characteristic is being used in the query. If an exit variable is not populating the contents of the variable correctly, try changing this setting to Refresh As Designed instead of the default Refresh Dynamically.</td>
</tr>
</tbody>
</table>

**Table 3.7** Properties of Characteristic: Advanced Tab
You can also change properties of display attributes, but the available options are much more limited. Only the General tab and the Value Display settings on the Display tab are available.

### 3.5.3 Rows and Columns Area Properties

Properties are also available for the Rows and Columns areas, accessible through the dropdown menu at the top of the Properties pane or by switching to the Rows/Columns tab and clicking the Rows heading or the Columns heading in Query Designer.

There is only one option available in the properties for either the Rows area or the Columns area: **Display as Hierarchy**. If this option is activated, all of the active drilldowns in either the Rows or the Columns section will be shown in a hierarchical format. This type of hierarchical view can be very useful for users who need to selectively drill down on an ad hoc basis to see detailed data in a pseudo-hierarchy across several different characteristics.

Figure 3.15 illustrates the impact of this setting. You'll notice that the rows section of the report is much narrower in the hierarchical view, as the characteristics are nested within a single column. This format is ideal for a summary level report, which can be included as a component in a high-level dashboard.

![Displaying Rows as a Hierarchy](image)

**Figure 3.15** Displaying Rows as a Hierarchy
You can control the default expansion level of the hierarchy with the Expand To option. The characteristic you select in the dropdown menu will be the lowest expanded level of the hierarchy when the report is run. Looking at the example in Figure 3.15, selecting Cost Center in the Expand To dropdown menu will only show the four cost centers, collapsed by default. Users would be able to expand each individual cost center to see data at the cost element level of detail.

When enabling the Display as Hierarchy setting for either rows or columns (or both), note that all of the items in the rows or columns pane are automatically included in the hierarchy. However, only the first characteristic or structure is labeled at the top of the first column of the report, so it is important to utilize training or inline documentation (more on this later) when running reports with hierarchical rows or columns.

It is possible to include characteristics with their own display hierarchies in the hierarchical view of the rows or columns. If the characteristic with the display hierarchy is not the last item in rows or columns, the user would need to expand to the lowest level of the characteristic's hierarchy to uncover the next characteristic.

Using Figure 3.15 as an example again, if the Cost Center hierarchy were enabled, Display as Hierarchy was enabled in the rows, and Expand To was set to Cost Center, the user would only see the Cost Center hierarchy by default (expanded according to the Hierarchy tab properties from Section 3.5.2). The user would then have to expand the Cost Center hierarchy to its lowest level, at which point one more expansion would reveal the Cost Element characteristic. However, if Expand To was set to Cost Element, the Cost Center hierarchy would be again expanded to its default level, with Cost Element displayed as the next level.

As you can see, enabling the hierarchical view of rows or columns can be a powerful tool, but it also has the potential for confusing users, especially those who are used to dealing with the traditional nonhierarchical view of rows or columns. Adding the display hierarchies of individual characteristics into the mix allows for the creation of a hybrid hierarchy that incorporates several different characteristics, but again this can cause usability issues if users are not aware of the structure of the query.

### 3.5.4 Structure Properties

Now let's use the dropdown menu at the top of the properties pane to select the Key Figures structure by expanding SHEET (Page) and Columns (Area). You can also
just click the Key Figures structure in the Columns section of the Rows/Columns tab in Query Designer.

As with the characteristic properties, the General tab for structure properties allows you to change the Description and the Technical Name of the structure. By default, a Key Figure structure will be labeled Key Figures. We usually end up renaming this structure to Columns, because from the user’s perspective it typically controls which columns are available in the report.

The technical name of the structure is only used when the structure is saved as a reusable object or when the structure is accessed from an external interface. Saving structures as reusable objects will be covered later in the book. For now, you can leave the technical name blank.

The Display tab offers just one setting, related to zero suppression. When the checkbox Structure as Group is checked, and zero suppression is enabled in the query properties, the structure will only be suppressed if all of the selections and formulas within the structure are zero. If this box is unchecked, individual selections and formulas within the structure will be suppressed if they only contain zeros.

As an example, let’s say a query structure contains one selection for Actual data (which contains data) and one for Plan data (which has not yet been populated). If Structure as Group is enabled, the user will see both the Actual and Plan columns in the query, even though the Plan column will be empty. If the setting is disabled, the user would only see the Actual column.

Note that there is no distinction between a selection that is hidden due to zero suppression and one that is hidden based on a filter value on the structure. For this reason, you may want to be careful when unchecking the Structure as Group checkbox in the structure properties if you want users to be aware that a specific column in the query is not populated with data.

### 3.5.5 Selection and Formula Properties

Several more properties are available for the components of structures: selections and formulas. Click one of the selections in the Key Figures structure, and take a look at the General tab in the Properties pane.

The General tab allows you to change the description of the selection, including adding text variables. This is the same functionality available in the Change
Selection screen. You can also add a technical name to the selection, which is useful when accessing the selection from an external interface (such as OLE DB for OLAP). The Edit button at the bottom is another way to access the Change Selection screen.

The Aggregation tab allows you to change the exception aggregation settings, which are only applicable to formulas and calculated key figures (covered later in the book). The default setting of Use Standard Aggregation means that data is aggregated to the displayed level in the query before the formula is calculated. If you select another option from this menu, you must select a reference characteristic. Data will then be aggregated by this reference characteristic before the formula is calculated.

Several additional options are available on the Display tab, as outlined in Table 3.8.

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hide</td>
<td>Controls whether the selection or formula is displayed in the structure. The default value, Always Show, means that the selection or formula is displayed by default, but can still be hidden by filtering on the structure. Other options include Always Hide, which is hidden by default and cannot be shown by filtering on the structure, or Hide (Can Be Shown), which is also hidden by default but can be shown by the user through the structure filter.</td>
</tr>
<tr>
<td>Highlight</td>
<td>The default value, Normal Display, shows data normally. The Highlighted Display option highlights the selection or formula based on the style used in BEx analyzer.</td>
</tr>
<tr>
<td>Number of Decimal Places</td>
<td>Controls how many digits are shown after the decimal place, from zero (0) to nine (0.000000000).</td>
</tr>
<tr>
<td>Scaling Factor</td>
<td>Can be used to scale the displayed value up, anywhere from a factor of 1 (default value, leaves the value unchanged) to a factor of one billion. For example, if the selection value is 34,500, and the scaling factor is 1000, the query would display 34 if zero decimal places are shown or 34.5 if one decimal place is shown. The scaling factor in use is displayed just under the selection heading, assuming Display Scaling Factors for Key Figures is checked in the Display tab of query properties.</td>
</tr>
</tbody>
</table>

Table 3.8 Properties of Selection/Formula: Display Tab
Properties for Queries and Query Components

3.5 Sign Change

Selecting the Reverse Sign option here will switch the sign on the displayed value from + to – and vice versa. This option does not affect the value of the selection or formula; it only changes the displayed value, so the original value will be used if included in any other formulas.

Status of Node

This option applies to structure components that are nested to form hierarchies within the structure — a parent node can be expanded or collapsed by default. Nested structure components are discussed in detail later in the book.

Table 3.8 Properties of Selection/Formula: Display Tab (Cont.)

The Advanced tab changes depending on whether we are looking at the properties of a selection or a formula. With a selection, the Constant Selection option is available. When checked, the Constant Selection box will make sure that selection is not affected by any other filters or variable selections in the query. A common example involves showing Actual and Plan data: if plan data is defined on a yearly basis, the value for the entire year is often stored in period 12. If you restrict the plan selection to period 12 and mark it as a constant selection, you will always see the plan data from period 12 regardless of any filters on the posting period.

The properties of a formula (or a calculated key figure, discussed later) will show an option for Formula Collision instead of Constant Selection. Later in the book, we will show how to create multiple structures in Query Designer. In instances where one structure includes a formula with multiplication or division and the other structure has a formula with addition or subtraction, the cell where these two formulas intersect is said to have a formula collision. In these cases, you can tell the query to use one formula over the other to ensure a consistent result, because due to mathematical order of operations the result may be different depending on which formula is evaluated. The Eliminate Formula Collision dropdown can be set to Use Result of This Formula, in which case the formula with the properties window open will be evaluated at the intersection cell. Alternatively, you can select Use Result of Competing Formula, which will use the formula from the other structure.

The next tab, Conversions, includes settings dealing with the conversion of currency and units. The first Conversion Type dropdown menu — for currency translation — is populated with the translation types created in Transaction RSCUR in your BI system. Once you select a currency conversion type, you can pick a target...
currency, or use a 0CURRENCY variable to allow the user to select a target currency. The next option is for unit conversion, and the conversion types here are populated from Transaction RSUOM in your BI system. As with currency translation, you can also select a fixed target unit from the dropdown menu or create a 0UNIT variable.

The Planning tab deals with settings specific to the BI Integrated Planning component. The options on this tab are disabled unless you have a planning query.

Finally, we have the Calculations tab. The settings on this tab can have a significant impact on how data is displayed in your query. The Calculate Results As dropdown box provides several options for how to determine the correct value for the results rows in the query. Normally, the results row will simply be a sum of the preceding rows, but you can use this setting to change the results row to a number of different possible calculations, including minimum value, maximum value, average, average of nonzero values, first value, last value, or a count of all values. One particularly useful option here — if you have set a scaling factor — is Summation of Rounded Values, which will add values after rounding has taken place. The default summation behavior will add values before rounding, which may lead to a discrepancy between the displayed values and the result. Note that the Calculate Results As setting has no effect on a characteristic with a display hierarchy shown.

The next dropdown box, Calculate Single Values As, allows you to control how the values in individual data cells are calculated. In addition to options such as minimum value, maximum value, moving average, or count (based on the characteristic displayed), you can also normalize the values to reflect a percentage of the characteristic result (Normalize According to Next Group Level Result), the Overall Result of the query, or the query result without taking into account filters set at runtime (Unrestricted Overall Result). Additional options exist to display values as a rank or Olympic rank.

The Cumulated checkbox will calculate the value of a cell by adding all of the previous cells within the characteristic (above or to the left), effectively creating a running total. The Also Apply to Results checkbox will apply the calculation method selected above to the results rows of the query.

Calculation Direction allows you to change how the query handles calculating results. A common example is a month-by-month breakout of financial data along the columns with a characteristic drilled down in the rows – results are calculated top to bottom first, then left to right. If you’d like a month-by-month running total, you would need to check the Cumulated checkbox and change the Calculu-
lation Direction to Calculate Along the Columns. The running total would then appear as the results row for each month.

Finally, the Use Precalculated Value checkbox applies to selections that contain a restricted key figure, a reusable component that will be discussed later in the book. With this box checked, the properties in the Calculations tab will be derived from the properties of the restricted key figure.

### 3.6 Summary: Query-Building Basics

In this chapter, we discussed the basic concepts necessary to build a BW query. Your first step was sourcing the data from an InfoProvider. Next, you set up hardcoded query-level restrictions in the Characteristic Restrictions and Default Values sections of Query Designer. Dynamic restrictions in the form of variables were introduced in the next section, along with the concept of hierarchies.

Once the query-level restrictions were in place, the next step involved populating the query layout. The process for creating a new Key Figure structure was introduced, allowing transaction data to appear in the query via selections and formulas. Drilldown capabilities were then added via characteristics drilled down by default in the Rows and Columns, and optional available drilldowns in the Free Characteristics.

Text variables were then introduced, allowing for dynamic labeling based on variable entries. The next topic involved setting offset values for variables and including variables in ranges.

Finally, we explored the properties available for the query itself and the query components. The properties pane for characteristics, the rows and columns areas, structures, selections, and formulas were discussed.

There are some more features available in Query Designer that were not discussed in this chapter, including multiple structures, the cell editor, exceptions and conditions, nesting selections, and reusable query objects. These features will be discussed later in the book, but first we will move on to the different methods available for running BW Queries.
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