

DB2 Query Management Facility  
Version 12 Release 1

*Introducing DB2 QMF*

**IBM**



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**Note**

Before using this information and the product it supports, be sure to read the general information under “Notices” at the end of this information.

This edition applies to Version 12 Release 1 of IBM DB2 Query Management Facility (QMF) Classic Edition and Enterprise Edition, which are features of IBM DB2 12 for z/OS (5650-DB2) and IBM DB2 11 for z/OS (5615-DB2). It also applies to Version 12 Release 1 of IBM DB2 QMF for z/OS (5697-QM2), which is a stand-alone IBM DB2 for z/OS tool. This information applies to all subsequent releases and modifications until otherwise indicated in new editions.

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## About this information

IBM® DB2® Query Management Facility™ is a family of tightly integrated, powerful, and reliable tools that help you access relational or multidimensional data in the IBM DB2 product family and beyond.

These topics are designed to help both administrators and end users with:

- Understanding new features in QMF™
- Understanding, at a high level, how each tool in QMF works
- Understanding the features offered in each of the different QMF tools

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## Service updates and support information

To find service updates and support information, including software fix packs, PTFs, Frequently Asked Questions (FAQs), technical notes, troubleshooting information, and downloads, refer to the following Web page:

IBM Software Support website

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## Highlighting conventions

This information uses the following highlighting conventions:

- **Boldface** type indicates commands or user interface controls such as names of fields, folders, icons, or menu choices.
- Monospace type indicates examples of text that you enter exactly as shown.
- *Italic* indicates the titles of other publications or emphasis on significant terms. It is also used to indicate variables that you should replace with a value.

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## How to send your comments

Your feedback is important in helping to provide the most accurate and high-quality information. If you have any comments about this book or any other documentation, use either of the following options:

- Use the online reader comment form, which is located at:  
<http://www.ibm.com/software/data/rcf>
- Send your comments by e-mail to [comments@us.ibm.com](mailto:comments@us.ibm.com). Be sure to include the name of the book, the part number of the book, the version of your product, and, if applicable, the specific location of the text you are commenting on (for example, a page number or table number).



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## Chapter 1. QMF at a glance

One of your most important assets is the operational data that forms the backbone of your business. Although many people at different organizational levels need access to this data, they might have different security levels, varying requirements for using the data, and a wide range of data processing skill levels.

The difference between hindsight and insight can often mean being able to quickly isolate and interpret the data that drives your business decisions.

DB2 Query Management Facility is a family of business intelligence tools that helps you transform business data on demand into a visual information platform that supports and encourages business growth by getting the right data to the right users at the right time in a format tailored to their precise operational needs.

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### Overview of QMF features

The QMF solution offers a robust set of functions that enable enterprise-wide access to business information across end-user and database platforms.

QMF is offered for a one-time charge price, and it is cost-effective because it is not priced per user. This pricing structure allows you to deploy content to as many users as you want at no additional cost, thus reducing your total cost of ownership.

The following features are provided by QMF:

#### **Relational and multidimensional queries**

Creation of both relational and OLAP queries is facilitated by a variety of different query interfaces that are tailored to different skill and knowledge levels. Multidimensional analysis capabilities allow you to drill down through an unlimited number of levels of detail, exposing underlying information with each click.

For more information, see Chapter 2, “Query functions,” on page 11.

#### **Reports, charts, graphs, and maps**

QMF offers an extremely flexible design environment for reports, allowing you to group, aggregate, and summarize data, add calculation expressions, and conditionally format the report depending on the query results. Dozens of visual elements can be embedded in reports by simply dragging the elements onto the report canvas, allowing you to create reports that are rich with graphical content, including charts, graphs, and maps. You can also save report formats as templates, applying them to different sets of query results to maximize reuse.

For more information, see Chapter 3, “Data display and analysis,” on page 23.

#### **Dashboards**

Dashboards provide a dynamic means of reviewing critical enterprise data. Unlike reports, which tend to contain a fixed amount of information, dashboards have the ability to deliver real-time information on demand, as needed by the dashboard user. QMF provides built-in methods of displaying query results, capturing user input, passing information to and

from the dashboard, implementing and streamlining navigation, defining relationships between visual elements, and pointing to underlying data sources.

For more information, see “Dashboards and visual applications” on page 32.

#### **Analytical functions**

QMF offers over 140 analytical functions, providing the repertoire of capabilities that you need to allow users with divergent needs to analyze trends and obtain summary-level information.

For more information, see “Analytical functions” on page 35.

#### **Data editing capabilities**

QMF provides built-in table editing capabilities that allow you to intuitively add, delete, and change entire rows or individual cells within a table.

For more information, see Chapter 4, “Data editing capabilities,” on page 37.

#### **Application development interfaces**

QMF offers a variety of application interfaces to allow you to seamlessly integrate QMF functions with either new or existing applications. You can also create, edit, and run sophisticated procedures to carry out a variety of tasks.

For more information, see Chapter 5, “Application development interfaces,” on page 39.

#### **Performance, resource control, and auditing functions**

QMF provides governing capabilities that allow you to set resource consumption limits by user or group, which allows role-based versus individual restrictions to be created. Activity logs provide built-in usage auditing capabilities, including several ready-to-use reports, so that you have a snapshot of each user's system activity at any given time.

For more information, see Chapter 6, “Performance and resource control,” on page 43.

#### **Multiplatform access to data**

You can configure QMF access to a wide variety of data sources, allowing you to create a unified business intelligence solution for your organization no matter how disparate your data sources may be. Additionally, after you create queries, reports, and dashboards, these objects can be deployed on virtually any platform.

For more information, see Chapter 7, “Portability and multiplatform access,” on page 47.

#### **Ease of use and administration**

The cost and complexity of implementing business intelligence solutions often results in a one-size-fits-all design for reports, dashboards, and other content. QMF stands out in the business intelligence market because it allows you to precisely tailor these objects to the operational needs as well as the security privileges of specific individuals or groups across your enterprise. Built-in wizards and other user assistance make QMF easy to learn and use, while drag-and-drop operations simplify the creation of objects.

For more information, see Chapter 8, “Ease of use and administration,” on page 51.

### **Multilingual capabilities**

QMF supports many national languages, speeding deployment of your content and giving your business a global edge.

For more information, see Chapter 9, “Multicultural support,” on page 59.

The QMF solution contains the following tools:

## **DB2 QMF for TSO and CICS**

QMF for TSO and CICS® provides powerful data access, manipulation, presentation, and application development functions that scale to many different database knowledge levels and can be customized in many ways to meet specific business needs.

QMF for TSO and CICS is tightly integrated with the z/OS® system architecture, which provides a fluid yet secure environment whereby applications, data, and business processes have access to existing resources managed with great flexibility, higher levels of utilization, and lower overall costs.

Customers running DB2 QMF for TSO and CICS are well positioned to deal with the exponential explosion of data, with the capability to sense and respond to market shifts and changing demands as they occur.

## **QMF Analytics for TSO**

QMF Analytics for TSO is a data analytics tool for business users and developers that allows you to analyze query results that are returned by QMF for TSO. It provides statistical analysis, forecasting functions, and additional chart types, all from an easy-to-use, menu-driven interface..

QMF Analytics for TSO consists of the following components:

- **QMF Analytics for TSO Charts**

The QMF Analytics for TSO Charts component presents query results graphically and makes that data more usable to a wider range of users.

You can run a query in QMF and then use QMF Analytics for TSO Charts to create a chart of the results quickly and with little effort.

- **QMF Analytics for TSO Statistics**

The QMF Analytics for TSO Statistics component provides a wide range of statistical analyses that you can run against QMF query results.

You can take the output of a statistical analysis or forecast, such as a graph, a chart, or a table of data and use it as a means to visualize, validate, and understand the patterns behind your data. This capability, when combined with your existing business knowledge, can help you make better-informed decisions.

In QMF Analytics for TSO, you can save a chart or statistical analysis specification as an ANALYTIC object by pressing the Save function key. You can then use the saved specification in a RUN QUERY command by including the ANALYTICS option in the command. You can also list, display, and erase an ANALYTIC object through the LIST, DISPLAY, and ERASE commands.

## DB2 QMF High Performance Option for TSO and CICS

DB2 QMF High Performance Option is a multifaceted tool that helps database administrators manage QMF objects and performance in the TSO and CICS environments.

DB2 QMF HPO consists of two major components:

- QMF HPO/Manager

Using QMF HPO/Manager, you can govern (pre-emptively and in real time) ad hoc and dynamic query and reporting activities. With easily collected, detailed information, you can more precisely control CPU resource usage at varying levels, according to any number of schedules applied to QMF user groups.

- QMF HPO/Compiler

With QMF HPO/Compiler, compiled programs that execute static SQL can be rapidly generated from QMF objects, thus saving processor cycles. It is especially beneficial for reports that are scheduled at regular intervals.

## DB2 QMF for Workstation

QMF for Workstation is a desktop application that provides an environment within which business intelligence objects such as queries, reports, and dashboards can be created, managed, and used. QMF for Workstation extends QMF functionality to the Windows, Linux, and Mac OS X operating systems.

QMF for Workstation offers multiple interfaces that help you build relational and multidimensional queries according to your level of SQL expertise. When query result data is returned, an assortment of intuitive editors can help you analyze, aggregate, and format the query results. You can also create and easily distribute content that can vary in format from classic page-based reports to more visually rich and interactive formats such as executive dashboards.

The administrative features of QMF for Workstation make it easy to configure connectivity to data sources and protect resource consumption on a per-user and per-group basis.

## DB2 QMF for WebSphere

DB2 QMF for WebSphere® is the DB2 QMF family's browser-based portal to business information on-demand. As a Web application, QMF for WebSphere provides a substantial subset of the QMF for Workstation query and reporting capabilities using a pure HTML, thin-client deployment model.

QMF for WebSphere makes it easy to provide the most frequently used QMF query and reporting capabilities to a large number of users quickly and easily. The thin-client model eliminates the need to install or maintain any additional software on multiple user machines. You can access QMF for WebSphere from any machine that has a Web browser. Support is provided for a variety of Web browsers across a number of platforms.

## QMF for Workstation versus QMF for WebSphere

QMF includes a rich client (QMF for Workstation) and a thin client (QMF for WebSphere) component.

The component you use depends on business and technical requirements specific to your situation. While all administrative functions (and a lot of the user

functions) available in QMF for Workstation are also available in QMF for WebSphere, there are some noteworthy differences.

The following list highlights functionality available in QMF for Workstation only. Most of these functions provide users the capability to design more robust reporting and dashboard solutions and enhance product usability.

#### **Enhanced visual design capabilities**

QMF for Workstation includes a visual designer for both reports and dashboards. With little or no coding experience, users can employ the visual designer to enhance the appearance and usability of reports and dashboards. Users can graphically place charts, selectors, and controls on a report canvas or dashboard design editor. Users can embed static content such as text, graphics, hyperlinks, and supporting information (data-driven or static). These elements can also be embedded in traditional tabular reports or interactive dashboards.

#### **Accessibility conformance**

QMF for Workstation conforms to accessibility standards and guidelines, including robust support for keyboard shortcuts.

#### **Bidirectional data transformation**

QMF for Workstation supports bidirectional (BIDI) data transformation. BIDI refers to supporting data processing of text in two directions, right-to-left (RTL) and left-to-right (LTR). By including BIDI support, QMF for Workstation is able to correctly display bidirectional text.

#### **Use of the host operating system scheduler**

QMF for Workstation includes support for using the host operating system's scheduler, in addition to the scheduler provided with the product. This allows for additional flexibility when scheduling tasks such as generating and distributing managed reports. With QMF for WebSphere, users are not able to use the host operating system scheduler. QMF for WebSphere users must use the scheduler that is included with the product.

#### **Enhanced drill-down editing capabilities**

QMF for Workstation provides enhanced capabilities, such as zoom editing and column dragging. The zoom editing presents the user with the capability to zoom in for a more detailed view of data on a scene or on a data point in a layout.

#### **Customizable perspectives and views**

QMF for Workstation provides the capability to customize workbench views. Users can move views around within the workbench, docking them in different locations to suit their preferences.

Additionally, QMF for Workstation users can customize the workbench by adding and removing views from the various perspectives. This allows users to establish standardized views and perspectives that suit their design needs.

#### **Document editing capabilities**

QMF for Workstation provides the capability to edit data in documents. For example, users can set font size and style as well as add color to text in documents.

#### **Support for REXX programming language**

QMF for Workstation supports the REXX programming language, so advanced "power users" can develop and implement scripts that address complex and repetitive tasks and functions.

### Targeted printing capabilities

QMF for Workstation supports targeted printing. Using QMF for Workstation, users can print a single document of interest. For example, users can perform a File > Print operation on a specific report or query result and get the output for that single piece of data.

### Table editing support in the data analysis grid

QMF for Workstation provides table editor support in the data analysis grid. This support is not provided in QMF for WebSphere.

### Seamless procedure-run EXPORT command

QMF for Workstation provides seamless support for procedure-run EXPORT commands. Users can run procedures to export data in various formats directly to their machines. QMF for WebSphere users can also use procedures to run EXPORT commands, but the process requires the user to download and save data through a download wizard.

## DB2 QMF Data Service

DB2 QMF Data Service provides increased flexibility for sharing and integrating mainframe with other data sources and applications.

DB2 QMF Data Service provides mainframe-resident data virtualization for real-time, universal access to data, regardless of location or interface.

## DB2 QMF Vision

DB2 QMF Vision provides companies with self-service dashboards that provide the capability to analyze data in an intuitive way. This capability enables users to dynamically adjust their analysis in accordance with their varying business needs. QMF Vision is easy to deploy on Cloud and on site, and requires minimum maintenance, which reduces overhead costs.

QMF Vision simplifies business intelligence (BI) for the organization and improves efficiency. It also facilitates sharing of analysis between multiple users to enable quick decision making through the collaboration feature.

- **Connect:** Users can view information the way they want to so that they can make informed decisions and take appropriate actions. QMF Vision provides interactive visualizations. Users can create reports and dashboards without IT support with the help of the drag-and-drop feature.
- **Discover:** QMF Vision has a comprehensive portfolio of integrated BI capabilities such as dashboards, files, and data. QMF Vision improves decision making across the organization by delivering timely business information to improve productivity. The solution is scalable and reliable.
- **Share:** Users can share dashboards for reuse across the enterprise. Real-time messaging service enables users to connect with each other. Because the solution is supported on various mobile devices, users can easily access dashboards and reports.

You can find information about installing QMF Vision in the *Installing and Managing DB2 QMF for Workstation and DB2 QMF for WebSphere®* guide.

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## What's new in Version 12 Release 1

The QMF family brings you even more business intelligence functionality in Version 12 Release 1, while at the same time providing improvements on traditional features and functions, to bring you even better value.

New improvements in QMF for Workstation and QMF for WebSphere allow you to reach a larger business audience than ever before, while QMF on the TSO and CICS platforms continues to provide robust features and functions. Continued interoperability between the host and distributed platforms through the use of the QMF object catalog allows you to repurpose legacy objects, such as queries and procedures, for users with little or no data processing knowledge.

## **QMF Classic Edition, QMF for Z/OS, and QMF Enterprise Edition changes**

QMF Classic Edition now consists of QMF for TSO and CICS, QMF HPO and QMF Applications (QMF Enhanced Editor and QMF Analytics for TSO). QMF HPO and QMF Applications are new components to QMF Classic Edition. Also, QMF for z/OS and QMF Enterprise Edition now include the QMF Data Service component in the existing suite of QMF for Workstation/WebSphere, QMF for TSO and CICS, QMF HPO and QMF Applications.

## **Access to non DB2 data sources (VSAM, IMS™, etc.)**

Using the QMF Data Service feature, QMF for z/OS, and QMF Enterprise Edition, you can access non-DB2 data sources. These data sources include but are not limited to: VSAM, IMS, SMF data, and many more. Data is retrieved through QMF queries and can be formatted and manipulated in traditional QMF forms. For the complete list of data source access available, reference the QMF publications.

## **Report preview options**

After proper setting of the DSQDC\_DISPLAY\_RPT global variable, you can enter a report mini-session, where queries can be run to view potential output without actually committing the results. The report mini-session can be useful for running and testing SELECT with change type queries. Upon exiting the report mini-session, you will be prompted to COMMIT or ROLLBACK the query.

## **Performance and storage improvements**

This release of DB2 QMF includes the following performance and storage improvements:

### **Additional database thread capabilities**

Using the new QMF program parameter option DSQSMTHD, you can use a second database thread. The second thread can be used for RUN QUERY and DISPLAY TABLE command processing. Usage of a second data base thread can assist with performance issues on SAVE operations with an incomplete report outstanding. Additionally, usage of the second thread can reduce storage requirements for SAVE DATA commands on large report objects because rows do not need to reside in storage but can be retrieved from the database and inserted into the new table as needed.

### **Increased fetch buffer size**

Using the DSQEC\_BUFFER\_SIZE global variable, the QMF internal storage area used to fetch data base row data can be increased. By changing the default from 4 kilobytes to a value up to 256 kilobytes, QMF can increase the amount of data

fetched in a single call to the database. Less calls to the database reduces the amount of time it takes to complete the report, which can result in significant performance improvements.

### **Query By Example (QBE) and Prompted Query (PQ) enhancements**

The QBE and PQ interface has been updated to support the TABLE keyword when specified on the RUN QUERY command.

### **Binary data formatting improvements**

The QMF FORM now allows the 'C' edit code for binary column data. This allows you to store known character data in binary columns to properly format report content.

### **QMF serviceability**

This release of DB2 QMF includes the following serviceability enhancement:

The global variable DSQEC\_TRACE\_MODULE allows administrators to limit the amount of QMF tracing diagnostics by QMF module name. The global variable allows up to six module names to be specified.

For additional information about any of these enhancements, see the QMF Version 12 Release 1 information in the IBM Knowledge Center at: <http://ibm.com/support/knowledgecenter/SS9UMF/welcome.html>

### **Enhanced Editor for ISPF Editor Users**

This release of DB2 QMF includes the following significant functionality and productivity improvements:

- Assist function extended to work with procedures as well as queries, and now also provides two types of assistance:
  - Information: about a keyword or SQL identifier, such as the structure of a table or syntax of a command.
  - Alternatives: selecting a table name to replace it with another table belonging to that owner, or selecting an SQL keyword shows other keywords of a similar type.
- More screen space is available for editing queries and procedures, while still maintaining the ability to see a preview of your query results including the ability to drill down on a preview row displaying it vertically. With an integrated list capability, you can also quickly browse your QMF objects and data tables including drilling down to individual row values.
- With better adherence to ISPF Editor conventions, ISPF users can adhere to ISPF standards when editing QMF objects. You can customize function keys to your own preferences using ISPF KEYS; navigate query previews and object lists using standard ISPF lists; and work with your QMF objects and data in a style more compatible with the ISPF Editor.

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## **What's new in QMF Version 11.2 for z/OS Fix Pack 2**

Several enhancements have been added to QMF Version 11.2 for z/OS.

## Enhancements applied to QMF Version 11.2 for z/OS Fix Pack 2

### Ability to publish objects to QMF Vision

QMF provides the ability to publish objects to the QMF Vision Objects folder and use them in dashboards and presentations in QMF Vision.

### Support for QMF Data Service data sources

QMF provides the ability to create QMF Data Service data sources and access the tables that are stored on the QMF Data Service server.

### Bulk change of user credentials in scheduled tasks

QMF provides the ability to change passwords for all repositories, repository connections, or data sources that are associated with the same user in a scheduled task.

### Enhanced work with visual dashboards and reports

QMF provides the ability to adding objects to the visual project by dragging the source query from the Repository Explorer tree to the editor area of the visual project.

### Web API for QMF for WebSphere

Web API for QMF for WebSphere provides a set of commands and tools for a third-party application to work with a repository. Use Web API to explore the tree of objects and data sources, run queries and procedures, and view result sets.

## Enhancements applied to QMF Version 11.2 for z/OS Fix Pack 1

### Improved appearance preferences

QMF provides the ability to define the font type and font size not only for headings and columns of query results and classic reports, but also for SQL and procedure editors.

### Batch Job Runner Exit Value

QMF notifies about the task status. If the task is completed successfully, the return code is 0. If the task fails, the return code is other than 0.

### Improved Query Builder Editor

Users can add tables or columns from Repository Explorer by dragging them to the **Tables** or **Fields** sections.

### Enhanced import of row condition from a file

QMF allows adding row conditions from a file of any format with the values that are separated by commas.

## Enhancements applied to QMF Version 11.2 for z/OS

### Enhanced QMF catalog structure

QMF provides the ability to group objects in folders by creating links to them in QMF Catalog. Copy, paste, or remove folders and links to objects in them to organize the work with objects in a convenient way.

### Enhanced procedures

- The RUN QUERY command provides the ability to save query results to a database.
- The RUN QUERY and IMPORT TABLE commands support the SPACE parameter that specifies the database and table space to that you want to save data.

### Virtual tables

QMF provides the ability to create virtual tables for processing the

collected data in the form of relational tables in virtual data sources. By using these tables users can edit the metadata in a convenient way, specify cache expiration schedules, and work with calculated columns.

#### **Enhanced work with queries**

- QMF provides the ability to run queries and other objects by clicking the Results tab for the first time.
- Enhanced Query Builder provides the ability to view the available ER diagrams from the specified data source and add or remove fields on the Build tab.

#### **New Results View**

Users can transform the Results tab into the editing view to see the processed results dynamically when they edit an application object.

---

## Chapter 2. Query functions

Depending on your QMF environment, QMF offers a number of different query methods to help you access and manipulate the data you need.

When the query results are returned, you can format the data into reports, charts, graphs, maps, or dashboards.

### **Related concepts:**

Chapter 3, “Data display and analysis,” on page 23

QMF provides business users and developers with extensive data formatting capabilities for transforming raw data into the insight needed to make critical business decisions.

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## Analytical queries

With analytical queries, you can combine data from multiple queries from the same or differing data sources into one result set.

In some situations, you might need to draw data from several different sets of data, some of which might be stored in different data sources. Querying each set of data one at a time can be time-consuming and ultimately adds unnecessary time and confusion to your query management process. Using analytical queries, you can combine query results from multiple queries that span different data sources into one query result set. You can add any number of queries in any number of combinations to your analytical query, allowing you to author one comprehensive result set that retrieves exactly the data that you need.

You can incorporate the following query types into an analytical query structure tree:

### **Append Query**

Append queries combine query results from two queries into one query result set. You can specify how the columns are paired across the two result sets.

### **Join Query**

Join queries join the result sets from two queries into one unified result set by joining one or more columns together, much like an SQL join operation.

### **Crosstab Query**

Crosstab queries provide a cross-tabulation of one or more columns, such as a sum, average, minimum, or maximum, computed over two or more tabulation columns. For example, tabulating the sum of product sales across the region and month.

### **Normalize Query**

Normalized queries “normalize” the text that is returned in a query result set. Normalizing query text facilitates query processing, such that executions of the same query with different parameters can be easily compared with one another and aggregated together.

### **Conditional Grouping Query**

With Conditional Grouping queries, you can create aggregated summaries of result set data based on conditional expressions.

## Column Filter Query

With Column filter queries, you can add a calculated column before or after existing columns and enter filtering functions.

The following screen captures show the different views of the Analytical Query editor:

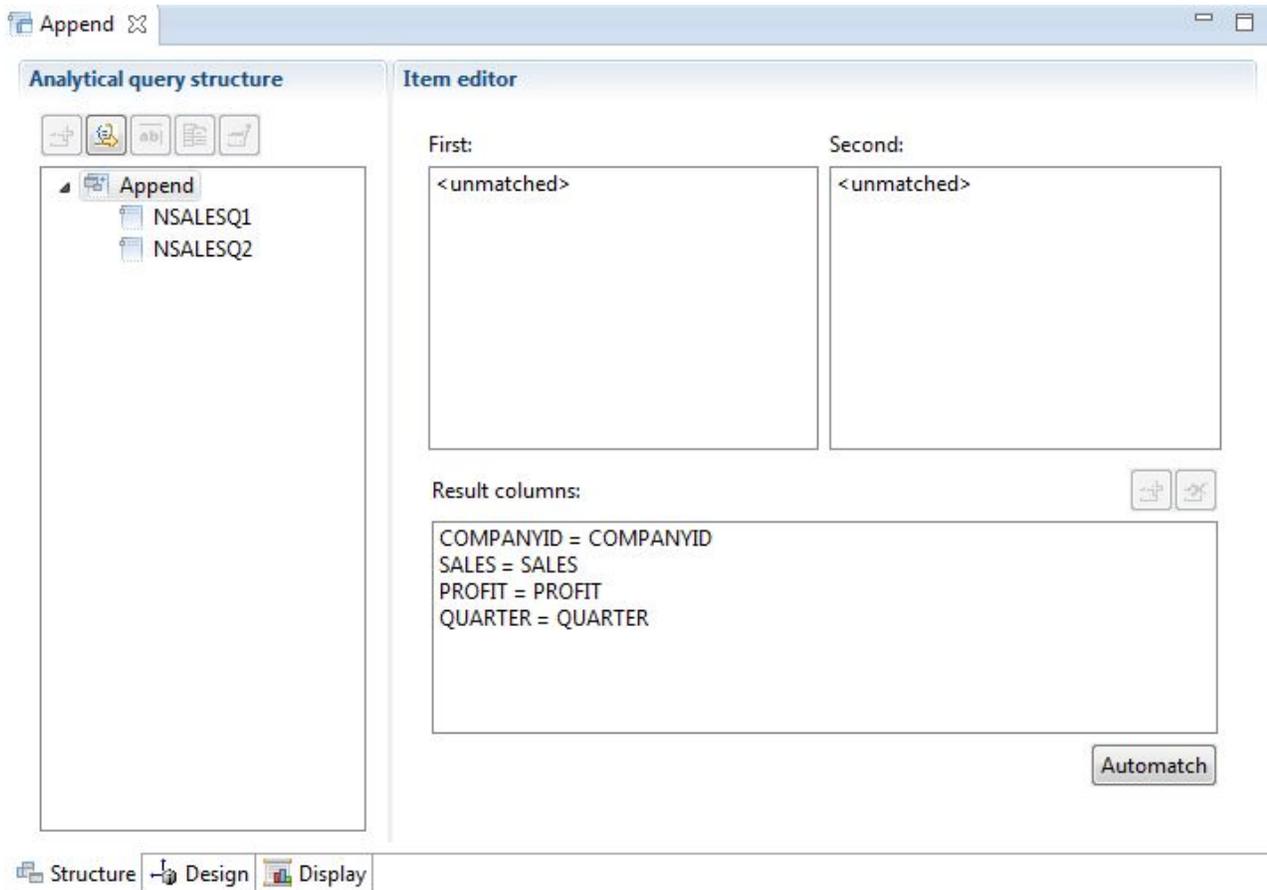


Figure 1. Append query type

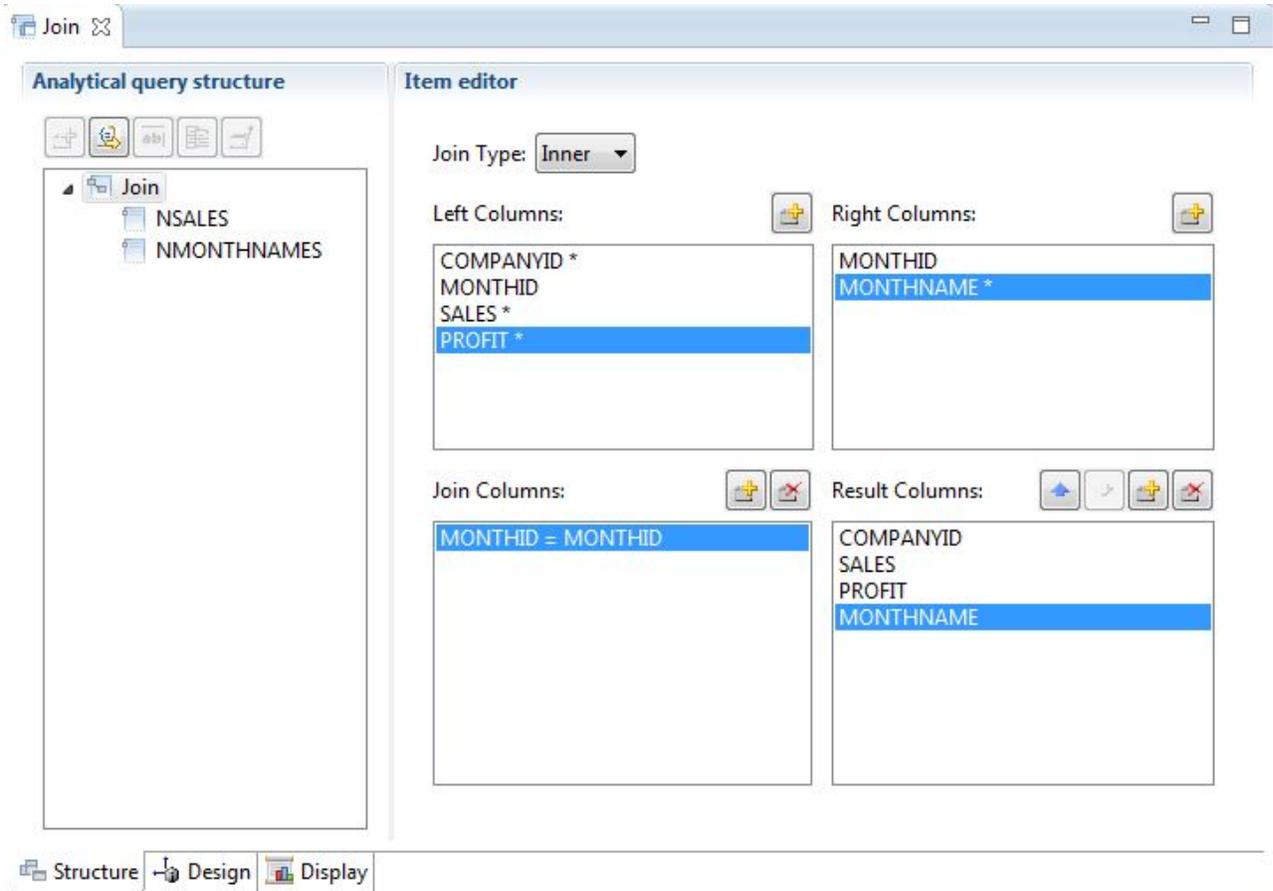


Figure 2. Join query type

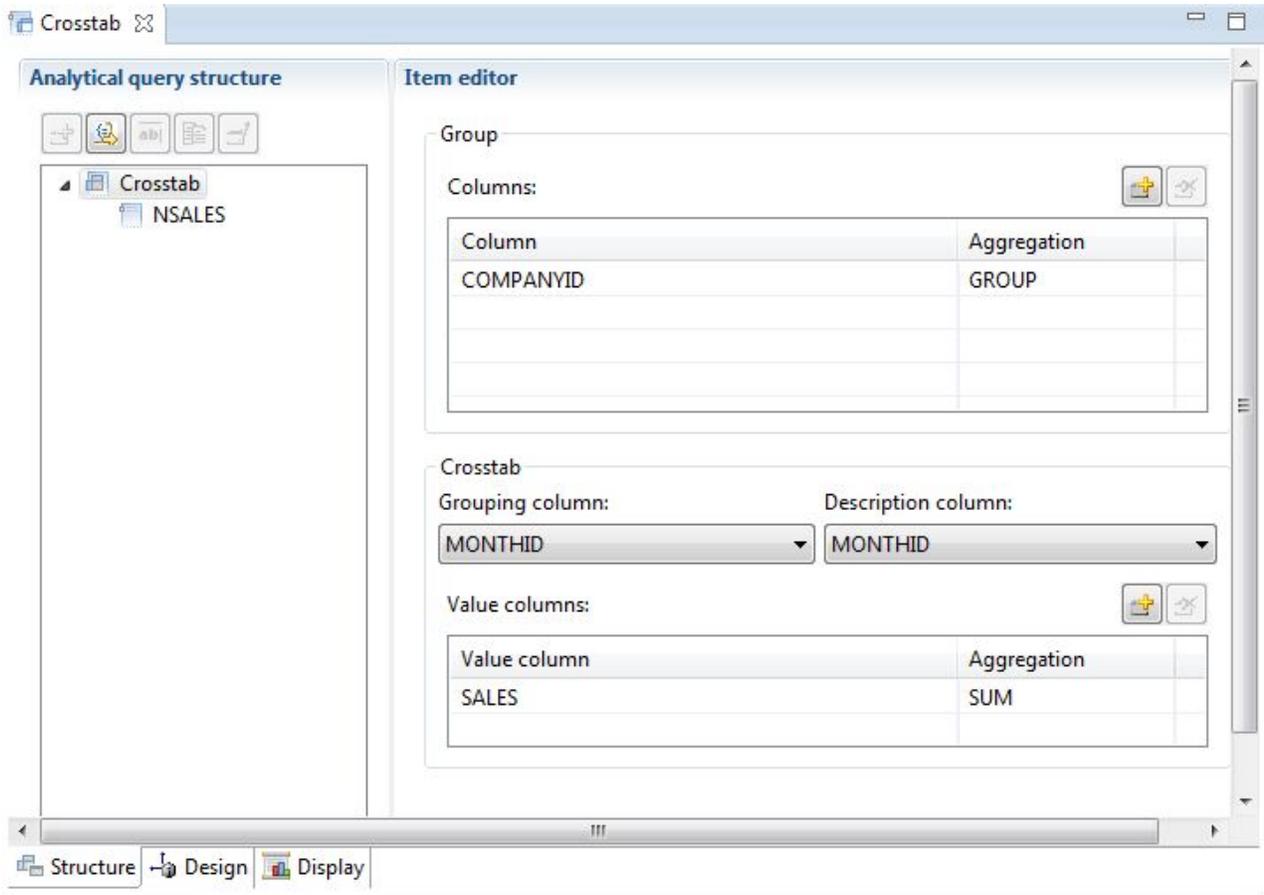


Figure 3. Crosstab query type

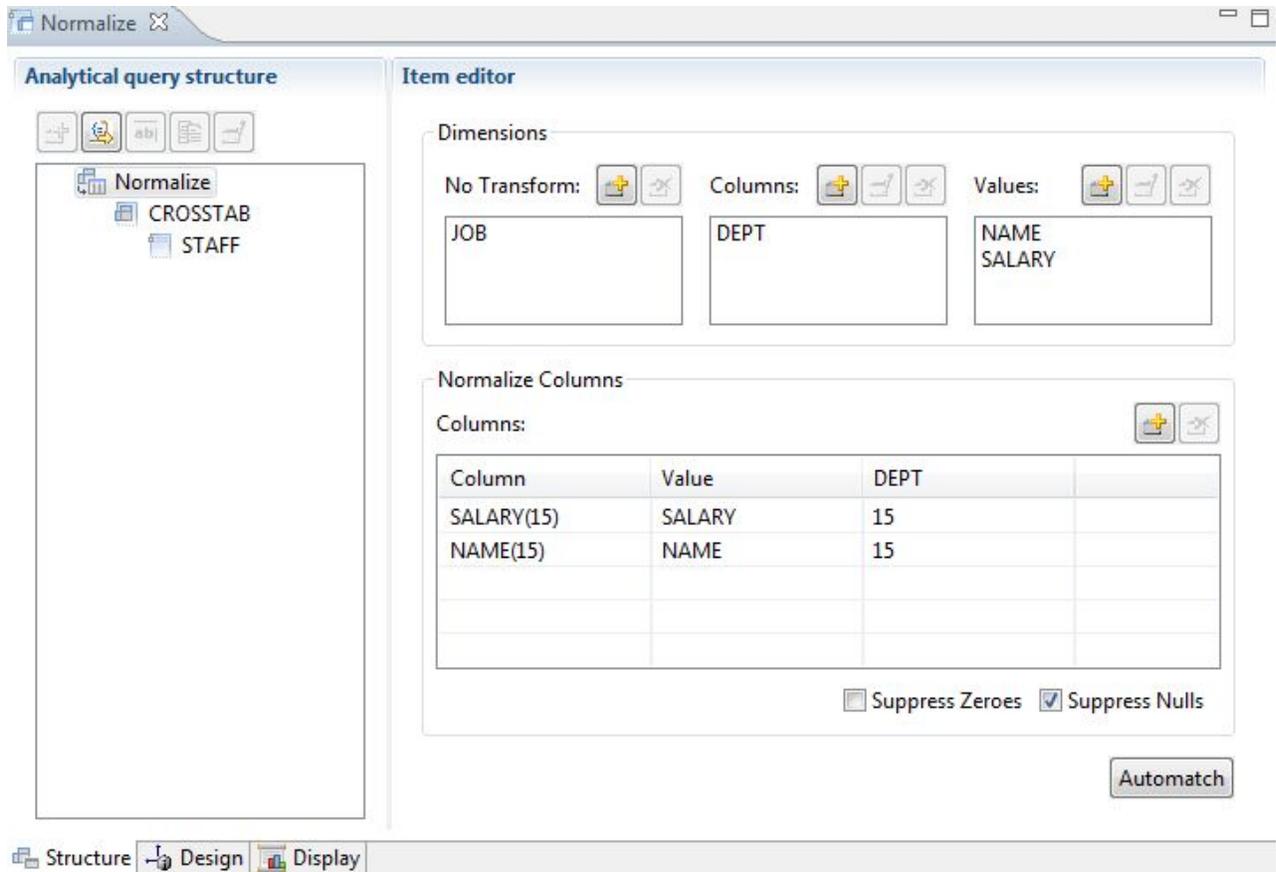


Figure 4. Normalize query type

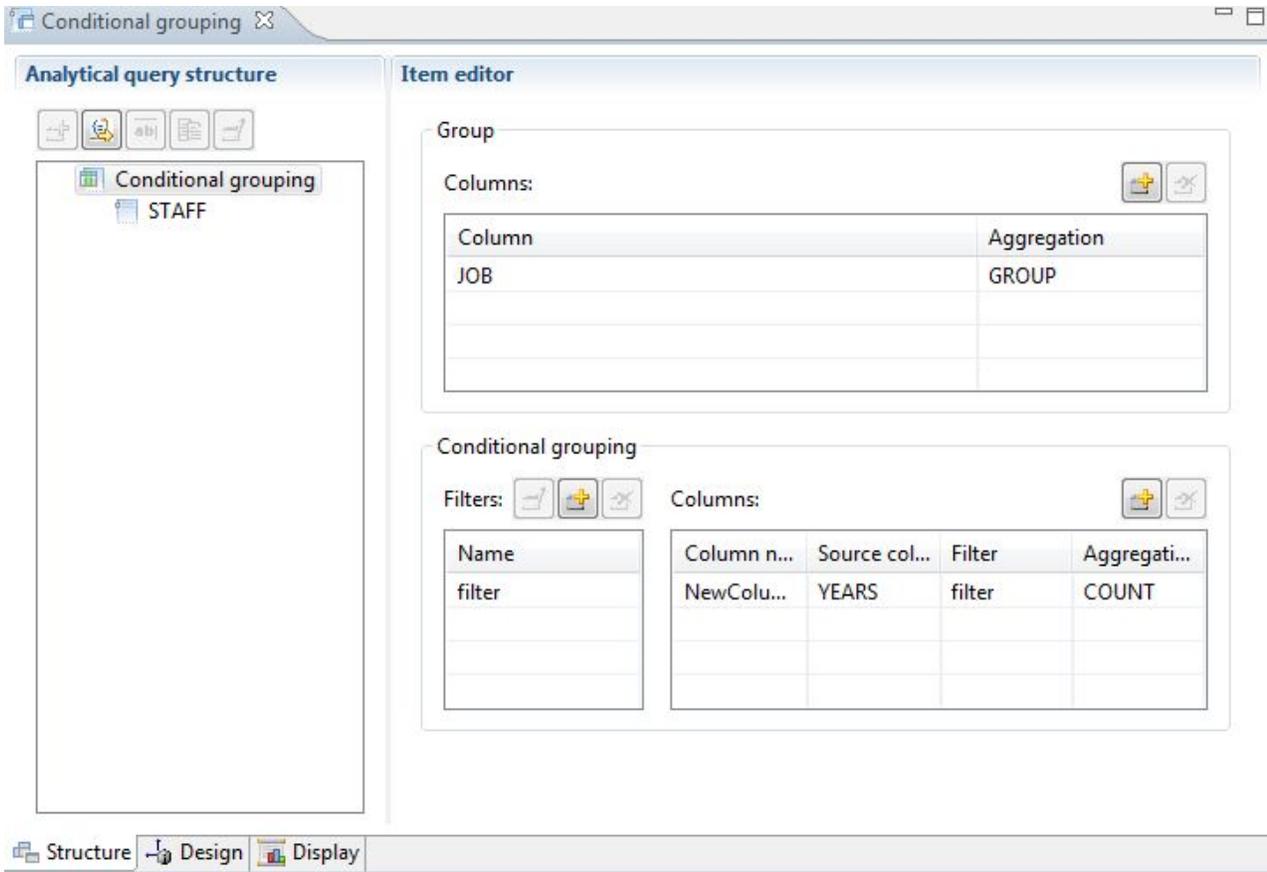


Figure 5. Conditional grouping query type

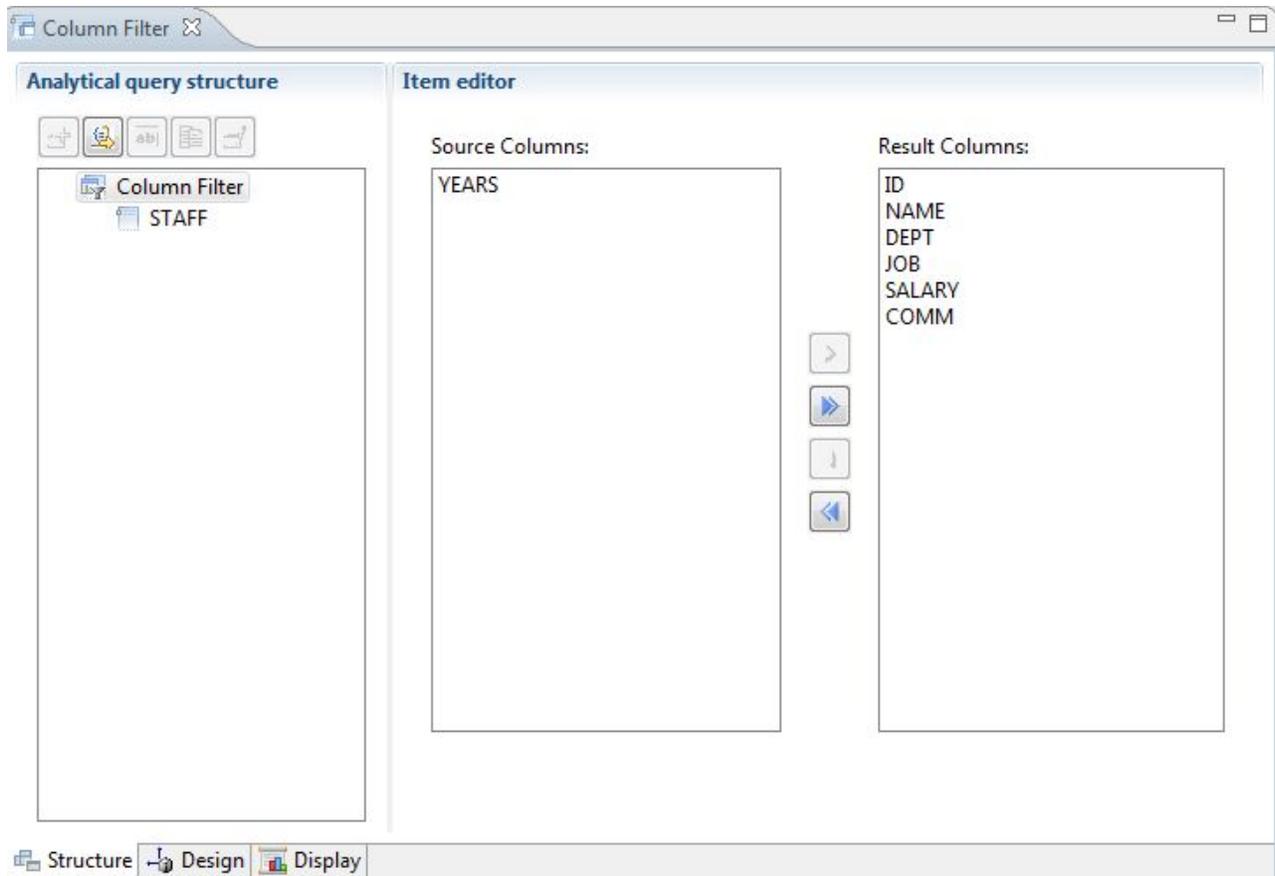


Figure 6. Column filtering query type

Multiple queries and tables can be added into the analytical query structure tree to generate a comprehensive result set that encompasses data from many different sources. The different options of each query type allow you to customize how this data is displayed.

## Relational queries

QMF offers different query methods depending on the user's level of SQL knowledge.

The query diagram designer in QMF for Workstation allows users to develop complex queries graphically, eliminating the need to write SQL. Users simply drag and drop database tables (real or virtual) and wire columns together to form joins between them, as shown in the figure below.

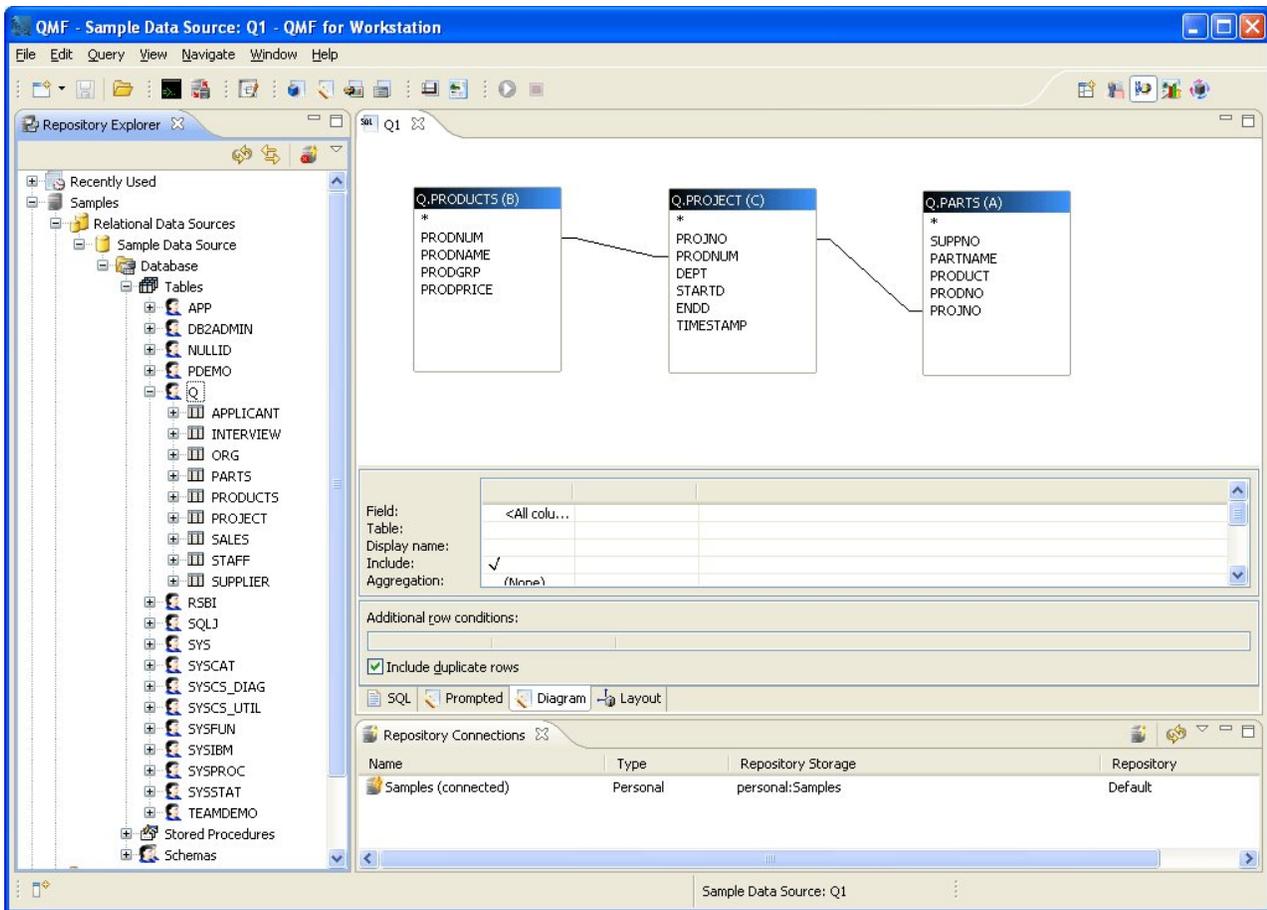


Figure 7. The query diagram designer in QMF for Workstation

Columns for display can be selected by double-clicking table fields; the companion column detail area allows users to select aggregations and ordering options, as well as row filters. Users can display the automatically-generated SQL at any time and move between the diagram, SQL, and prompted query views, or develop the query using all three types of views.

## Prompted queries

Prompted Query is an easy-to-use query method available in all QMF environments. The Prompted Query dialog prompts you for the necessary information to build a query.

Prompted Query is designed for the beginner and occasional QMF user who wants to build a query but does not know SQL. QMF guides you through the steps and checks to ensure that the statement you build is valid.

The layout of the panels, dialogs, and pages that request the information for a prompted query is similar in QMF for TSO/CICS and QMF for Workstation/WebSphere. Once you become familiar with one interface, you can use another without wasting time learning a new method.

The following figure shows a sample prompted query in QMF for Workstation. To see SQL statements that are equivalent to the prompted query in QMF for Workstation and WebSphere, simply click the SQL tab at the bottom of the interface window. Being able to see the SQL as it is generated can help users learn

SQL.

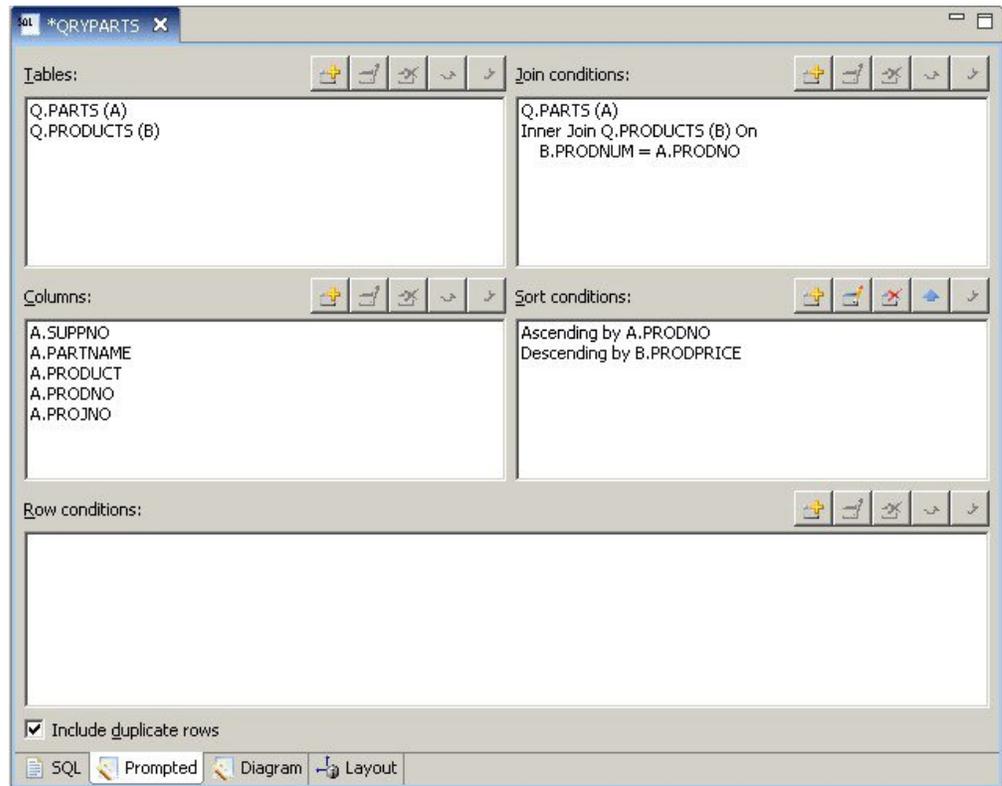


Figure 8. Sample prompted query in QMF for Workstation

The following panel shows a partially completed prompted query in QMF for TSO and CICS. To see the equivalent SQL statements, you can use the SHOW SQL command or function key after the prompted query is built.

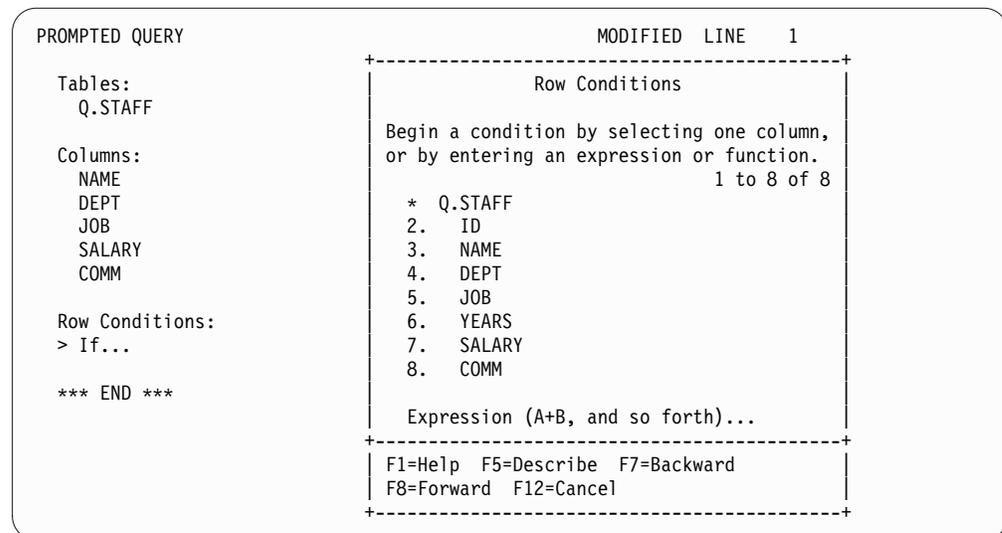


Figure 9. Sample prompted query in QMF for TSO and CICS

Not only can you see the generated SQL, you can also modify it if necessary. In QMF for Workstation and QMF for WebSphere, you always have live access to the

SQL statements by clicking the SQL tab. In QMF for TSO and CICS, you can convert the query to SQL using the CONVERT command and then continue to modify the SQL if necessary.

## SQL queries

QMF for TSO and CICS, QMF for Workstation, and QMF for WebSphere provide ways for experienced users to issue SQL statements directly to the database.

If you do not know the exact syntax of the SQL statement you need or you just want to save time, you can have QMF for TSO and CICS as well as QMF for Workstation draw a sample SELECT, INSERT, or UPDATE query for the table you are working with, and then change this sample query as necessary.

QMF for Workstation offers additional help in creating syntactically correct SQL queries with a colorized SQL editor that includes Content Assist and Parameter Hint features. The Content Assist feature supplies lists of all the elements (such as keywords, separators, clauses, current table and column names, and other elements) that can occur in a specific place in your SQL statement based on what you have already specified. The Parameter Hint feature supplies information about the parameters required by the current function in your SQL statement.

SQL queries can include multiple SQL statements, allowing you to accomplish many different database tasks with a single query. The text of the query is limited only by the length of SQL statement that the database to which the query is directed is capable of running. In the TSO and CICS environments, CALL and CREATE PROCEDURE statements must be used alone in a SQL query.

---

## Multidimensional queries

QMF for Workstation and QMF for WebSphere support multidimensional analysis through the use of OLAP queries.

OLAP queries are multidimensional queries that can present your cube data in a wide variety of views. You can drill up, down, or across through a user-defined set of dimensions and levels by using the built-in OLAP explorer. You can then use the OLAP query diagram to create a new OLAP query, or open an existing query and modify it to obtain different views of the cube data.

A multipane OLAP editor provides side-by-side views of the cube and the OLAP query that you are creating, as shown in the following figure. Dimensional filtering allows you to include only the data that you want to analyze, increasing the efficiency of retrieving data from larger cubes. Hierarchical dimensional filtering allows you to filter dimension levels in relation to the cube contents. For example, a view of the second quarter can be filtered across all years or merely across a designated list of years. At any given time, you can view the underlying SQL or MDX statements that have been automatically generated in response to a query that you have created graphically.

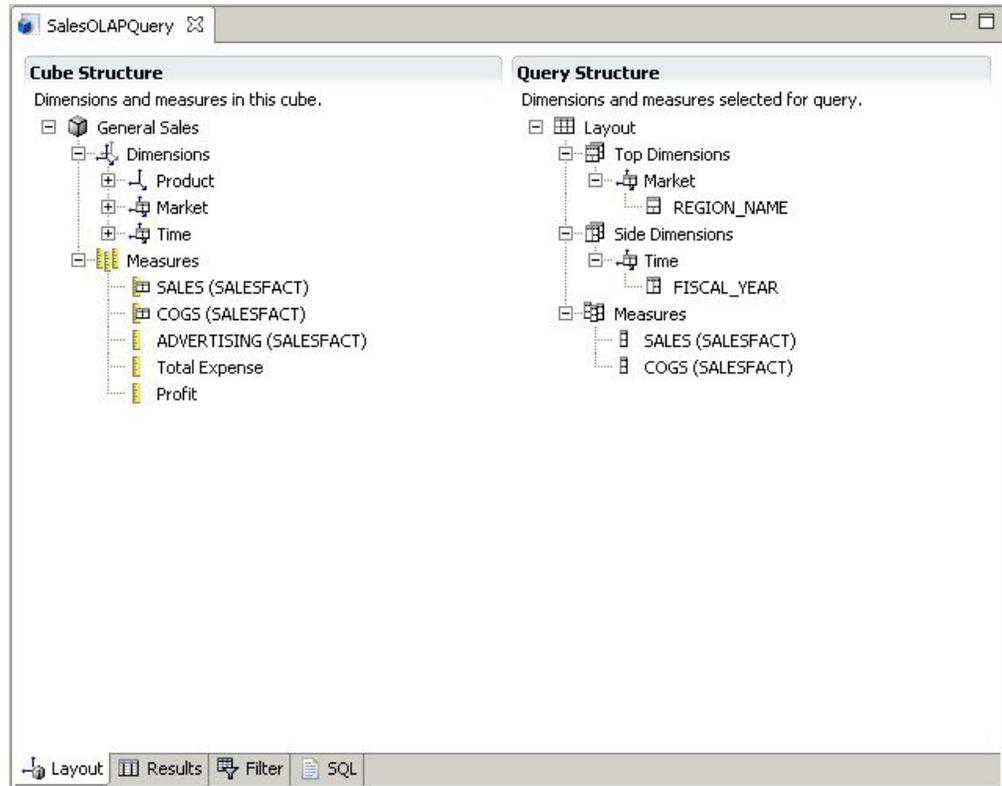


Figure 10. The multipane OLAP editor, which provides two different views of an OLAP query

As with relational queries, QMF for Workstation and WebSphere offer multiple methods of constructing multidimensional queries. You can browse available cube models and construct queries by graphically dragging and dropping dimensions and measures of interest into your queries and immediately see the results of your selections. Although no coding knowledge is required to browse and construct OLAP queries, experienced users can open the Multidimensional Expressions (MDX) editor and directly enter or edit the query's underlying MDX statements. You can also switch between the MDX and graphical editors, building the query by using a blend of both methods.

You can format OLAP query results directly in the query results editor, which provides many options, including the ability to:

- View summary information for a measure or dimension
- View only totals for a measure or summarized dimension
- View detailed data for a summarized dimension
- Resize columns
- Change the font or format for a measure or dimension

OLAP cube data can be displayed in both QMF for Workstation and QMF for WebSphere, and can be directly incorporated into visual reports and dashboards by using the OLAP-aware charts, graphs, and dimension slicers in QMF for Workstation.



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## Chapter 3. Data display and analysis

QMF provides business users and developers with extensive data formatting capabilities for transforming raw data into the insight needed to make critical business decisions.

From reports, charts, dashboards, visual applications, and statistical analytics, QMF redefines the traditional notion of how to formulate and disseminate business data. QMF provides users with the capability to customize data presentation to meet the needs of different types of users. In addition to traditional page-based reports, business users and developers can create dashboards and visual applications to present live operational data to a wide range of users.

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### Graphical reports

Graphical reports, also referred to as *visual reports*, implement graphical elements to make the report data more visually appealing and to enhance usability by displaying data graphically in chart or graph formats.

QMF for Workstation provides an intuitive visual designer that enables business users with no coding experience to design reports that can include a variety of charts and graphs, as well as embedded content such as text, graphics, hyperlinks, and supported information that is both static and data-driven.

The visual designer allows you to:

- Control virtually any visual attribute on a report, chart, graph, map, or dashboard.
- Include conditional formatting in queries, reports, and dashboards.

Conditional formatting allows you to specify conditional expressions that control both the display of the data as well as the behavior of a query, report, or dashboard element (what it does when clicked or changed, based on the underlying data). For example, you can use conditional formatting to highlight in red any fields that indicate that year-end sales have fallen below a particular figure.

- Specify calculation expressions to generate columns from columns stored in the database.
- Group, aggregate, and summarize data.

The following figure shows an example of a visual report in QMF for Workstation.

DEPT	JOB	NAME	YEARS	SALARY	COMM	
10	Mgr	Molinare	7	22959.20	0.00	
		Lu	10	20010.00	0.00	
		Daniels	5	19260.25	0.00	
		Jones	12	21234.00	0.00	
<b>Department Total:</b>			<b>8.5</b>	<b>83463</b>	<b>0</b>	
15	Clerk	Ngan	5	12508.20	206.60	
		Kermisch	4	12258.50	316.70	
				4.5	24767	317
	Mgr	Hanes	10	20659.80	0.00	
					10.0	20660
Sales	Rothman	7	16502.83	1152.00		
<b>Department Total:</b>			<b>6.5</b>	<b>145393</b>	<b>1469</b>	
20	Clerk	James	0	13504.60	128.20	
		Sneider	8	14252.75	254.70	
					8.0	27757

Figure 11. Example of a visual report in QMF for Workstation

## Tabular reports

Tabular reports in QMF for Workstation provide users with the capability to formulate and present raw data from query results in a tabular report. The design interface includes a Design view for designing and structuring report data and a Runtime view for viewing how the report output is displayed.

The following figure shows an example of a tabular report in Design view.

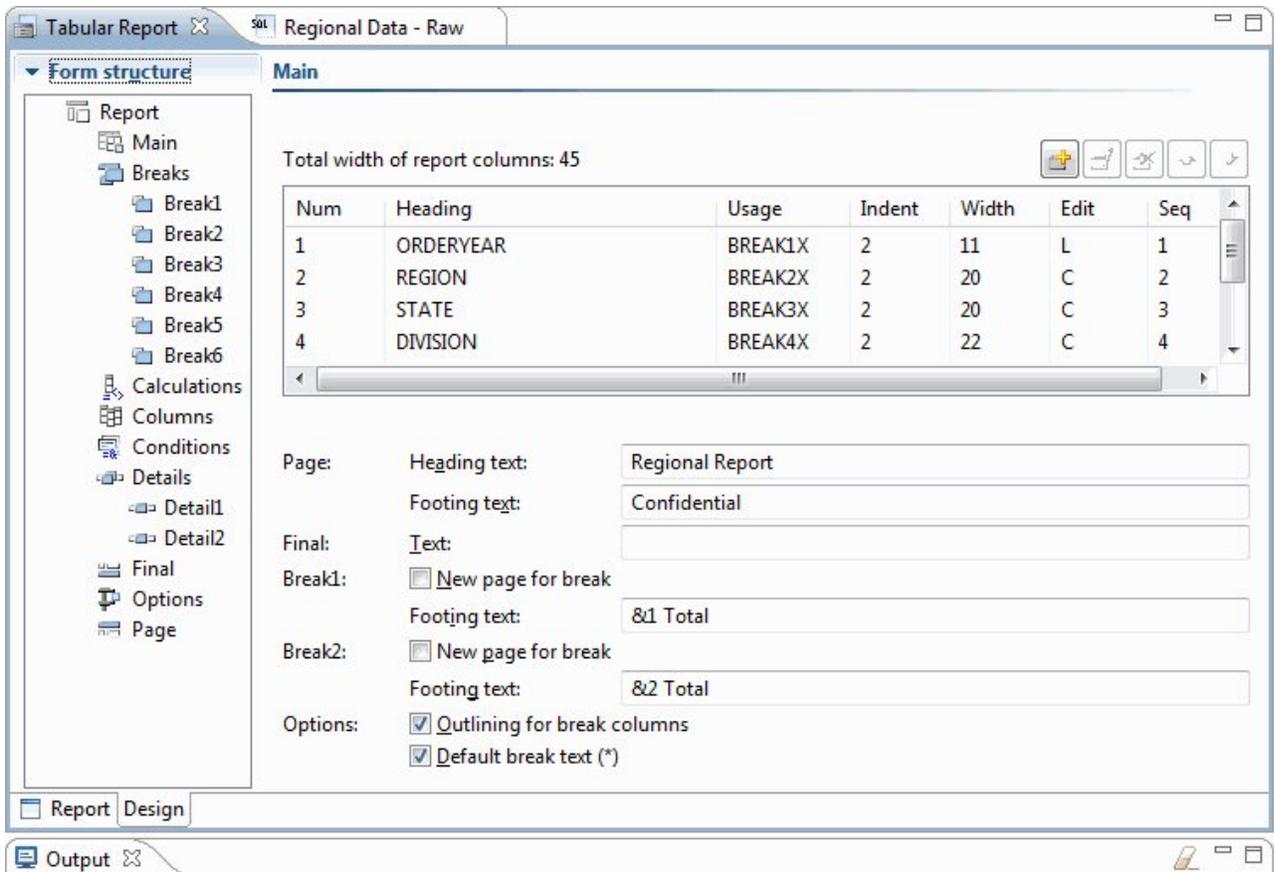


Figure 12. A tabular report in Design view

The following figure shows an example of a tabular report in the raw data view.

	1	2	3	4	5	6
	ORDERYEAR	REGION	STATE	DIVISION	ORDERMONTH	AMTK
1	2004	EAST	California	Institution	10	889
2	2004	EAST	California	Institution	11	710
3	2004	EAST	California	Institution	12	706
4	2004	EAST	California	Retail	10	1186
5	2004	EAST	California	Retail	11	1009
6	2004	EAST	California	Retail	12	1090
7	2004	EAST	California	Wholesale	10	693
8	2004	EAST	California	Wholesale	11	803
9	2004	EAST	California	Wholesale	12	969
10	2004	EAST	Nevada	Institution	10	251
11	2004	EAST	Nevada	Institution	11	379
12	2004	EAST	Nevada	Institution	12	372
13	2004	EAST	Nevada	Retail	10	654
14	2004	EAST	Nevada	Retail	11	624
15	2004	EAST	Nevada	Retail	12	723
16	2004	EAST	Nevada	Wholesale	10	808
17	2004	EAST	Nevada	Wholesale	11	599
18	2004	EAST	Nevada	Wholesale	12	774
19	2004	EAST	Oregon	Institution	10	150
20	2004	EAST	Oregon	Institution	11	204

Figure 13. A tabular report in the raw data view.

The following figure shows an example of a tabular report in the default view.

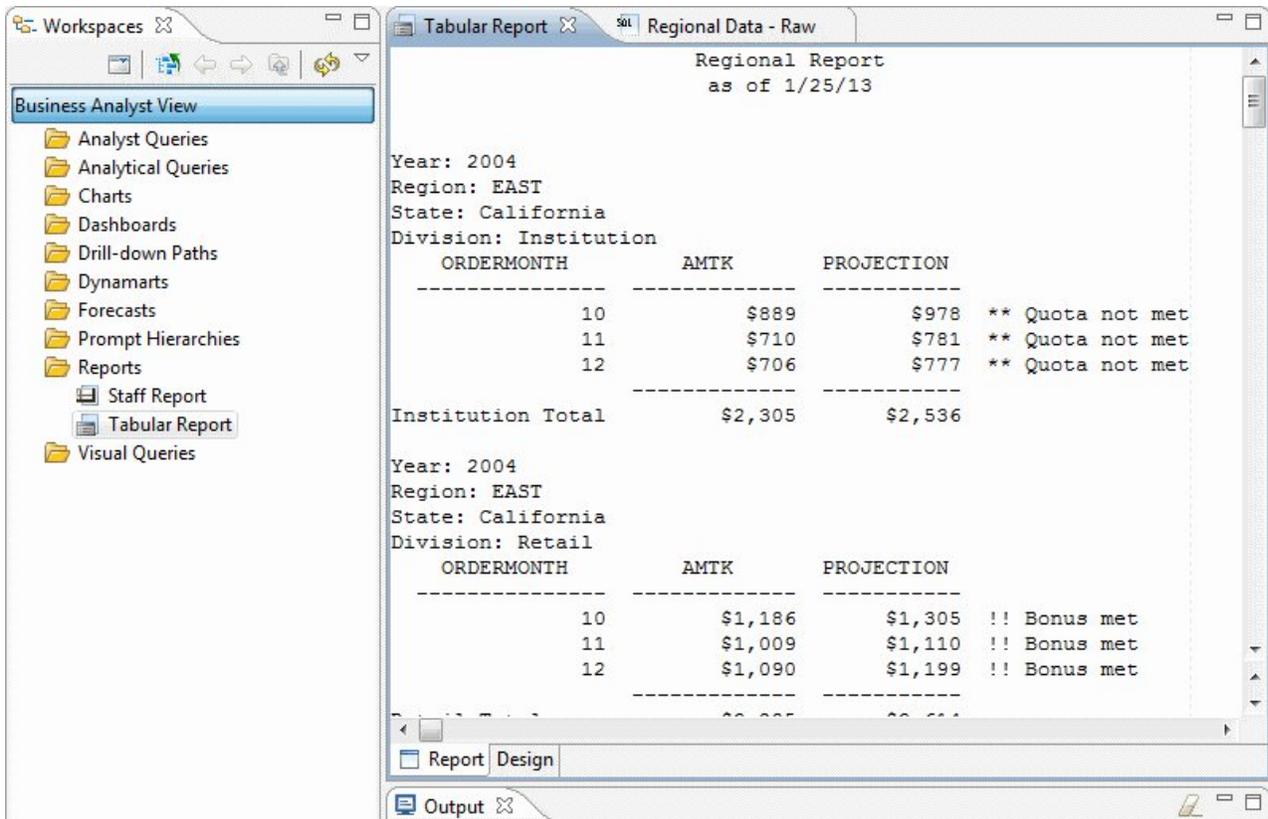


Figure 14. A tabular report in the default view.

Creating custom tabular reports with QMF for TSO and CICS is easy; you can start with a template report that has default column headings and a default layout. Then you can tailor the default report with formatting specifications that control different areas of the report.

The following figure shows a report produced in QMF for TSO and CICS that groups salaries in each department by job.

REPORT	LINE 1	POS 1
<----- JOB ----->		
<-- CLERK --> <-- MGR --> <-- SALES --> <-- TOTAL -->		
	SUM	SUM
DEPT	SALARY	SALARY
-----	-----	-----
10	\$83,463.45	\$83,463.45
15	\$24,766.70	\$20,659.80
20	\$27,757.35	\$18,357.50
38	\$24,964.50	\$17,506.75
42	\$22,014.50	\$18,352.80
51	\$27,829.80	\$21,150.00
66	\$10,988.00	\$18,555.50
84	\$13,030.50	\$19,818.00
	=====	=====
	\$151,351.35	\$217,863.80
		\$214,432.33
		\$583,647.48
ABC Mechanical, Inc.		

Figure 15. A tabular report in QMF for TSO and CICS

Using QMF for TSO and CICS forms, you can change text, spacing, and alignment on virtually any area of the report. You can also:

- Group, aggregate, and summarize data.
- Define new columns not originally present in the query results.
- Perform calculations on your data using either simple operators or REXX expressions.
- Define conditional formatting, which allows you to define data-dependent formatting variations for the report.
- Fix columns in a large report so that you can easily compare later columns against earlier ones.

When you make changes to a QMF form, you can see the results immediately on the report without having to repeatedly fetch information from the database.

The QMF form object is composed of the following nine panels on which you indicate your report formatting specifications.

**FORM.MAIN**

Used to specify the basic format for the report

This form panel is shown in Figure 16 on page 29.

**FORM.BREAKn**

Allows you to specify text before and after breaks in a report

There are six break panels (FORM.BREAK1 through FORM.BREAK6), allowing you to specify summary text for up to six breaks in the report.

**FORM.CALC**

Allows you to specify up to 999 calculation expressions in a report

**FORM.COLUMNS**

Allows you to specify the format of columns in the report as well as how to format the data in each column when that data appears in a chart

**FORM.CONDITIONS**

Used together with FORM.DETAIL to specify conditional formatting in the report

Conditional formatting allows you to create expressions that control when the formatting variations that have been specified in FORM.DETAIL are to be used in the report. If the condition evaluates to true, the formatting specifications associated with that condition are applied to the report.

**FORM.DETAIL**

Allows you to create up to 99 formatting variations, each associated with a condition that you specify on the FORM.CONDITIONS panel

**FORM.FINAL**

Controls the content and placement of final text in a report

**FORM.OPTIONS**

Allows you to fix the position of columns in the report, which divides the report into a fixed area and a scrollable area, so that you can easily compare multiple columns in a large report

This panel also allows you to summarize data across columns in the report as well as make other detailed formatting adjustments.

The following figure shows formatting options available on FORM.MAIN, the main panel of the QMF form. If all the columns in the form are not visible on the

panel, you can scroll forward and backward to see those you want.

```

FORM.MAIN                                MODIFIED
COLUMNS:                                Total Width of Report Columns: 23 + (N X 15)
      A                                B C D E F
NUM  COLUMN HEADING                      USAGE  INDENT  WIDTH  EDIT  SEQ
-----
1  DEPT                                GROUP   2      6      L      1
2  JOB                                ACROSS  2      5      C      2
3  SALARY                              SUM     2     11     D2     3

PAGE:  HEADING  ==> G
      FOOTING  ==> COMPANY NAME
FINAL:  TEXT    ==> H
BREAK1: NEW PAGE FOR BREAK? ==> NO
      FOOTING  ==> DEPT. &2 TOTALS I
BREAK2: NEW PAGE FOR BREAK? ==> NO
      FOOTING  ==>
OPTIONS: OUTLINE? ==> YES      DEFAULT BREAK TEXT? ==> NO J

1=Help      2=Check      3=End      4=Show      5=Chart      6=Query
7=Backward  8=Forward      9=        10=Insert   11=Delete    12=Report
OK, FORM.MAIN is displayed.
COMMAND ==>                                SCROLL ==> PAGE

```

Figure 16. Formatting options on the FORM.MAIN panel

With these entry areas, you can do the following tasks:

- A** Assign column headings.
- B** Specify a usage code for the column, which indicates how to group, summarize, or aggregate the data in the column. For example, you can choose to summarize data across the rows in a report in addition to within each column.
- C** Adjust the indentation of each column.
- D** Adjust the width of each column.
- E** Specify an edit code for the column, which indicates how values in the column are to be formatted.  
  
QMF provides default edit codes for each data type as well as an edit exit interface to allow you to create your own codes and associate them with formatting routines. For example, you can format values in scientific versus decimal notation or control the sign and separators for monetary values.
- F** Change the sequence of columns.
- G** Specify a heading and footing for the top and bottom of each page.
- H** Specify the final text at the end of the report.
- I** Enter footing text to use when the value in a designated control column changes.
- J** Specify the formatting of repeated values within a designated control break.

You can apply the same formatting specifications to different sets of query results, saving you time and helping you to maintain reporting consistency across your organization.

---

## Quick reports

Quick reports in QMF for Workstation provide users with a way to create, customize, and generate reports expediently and extemporaneously.

You can use the Create New Quick Report wizard to define the report "break" sections and determine the columns over which data will be reported. For example, you can report sales by region, followed by country within each region. In the Create New Quick Report wizard, you can also define the aggregation function applied to each column value (ascending, descending, count, maximum, minimum, sum, average, and so on). You can also define the formatting (text, alignment, font, background color, and so on) of both the detail and summary rows of the report.

After generating a quick report, users can apply updates to the original object (if permission is granted) or save the changed report under a new name. If you choose the latter, the object is still linked to the original query or queries and automatically reflects any changes that are made to the originals.

---

## Ad hoc reports

Ad hoc reports in QMF for Workstation provide users with a way to create and generate reports that meet individual users' design requirements quickly and easily.

Ad hoc reports use a canvas and scenes to graphically represent information retrieved from a database. They provide an extempore and user-friendly way to design reports.

When creating a report, you can place multiple objects on the Canvas and manage the Canvas space to suit to your purposes. Typically, the Canvas represents what you believe to be the most appropriate set of data objects.

The Canvas Internal Tree displays the contents of your home workspace and allows you to add the objects contained in it to your report.

---

## Charts

QMF for Workstation provides a graphical palette that contains 20 default charts and graph styles, listed below. QMF for TSO and CICS provides a subset of these styles through IBM Graphical Data Display Manager-PGF (GDDM-PGF) and Interactive Chart Utility (ICU).

QMF Analytics for TSO is an optional feature that you can access from within QMF for TSO. QMF Analytics for TSO provides a similar subset of the charts that are supported in QMF for TSO, as well data analysis capabilities.

- Line charts
- Bar charts
- Pie charts
- Column charts
- Scatter charts
- XY charts
- Stock charts
- Candlestick charts

- Timeline charts
- Event band charts
- Multivariate charts
- Linear maps (geospatial)
- Hierarchical charts
- Organization charts
- Cluster graphs
- Tree charts
- Spiral charts
- Simple form layouts
- Matrix layouts
- Horizon charts

In addition, query results can be automatically sent to Microsoft Excel for viewing in pivot charts. Microsoft Excel must be installed separately to take advantage of this feature.

---

## Statistics and forecasts

With QMF, you can run a variety of statistical analyses against query results and use the returned information to identify trends and predict future events.

### QMF for Workstation forecasts

With forecasting capabilities, you can make projections of future values based on past values. Using forecasts, organizations can prepare for changes in economic or competitive conditions by analyzing time series historical data to predict performance and future trends. For example, in a supply chain, if the forecast demand matches the actual demand then significant efficiencies can be achieved in terms of production, distribution, and return.

Using QMF for Workstation forecasts you can apply various predictive methods based on mathematical algorithms that model the future demand based on time series historical data that can be sourced from queries and tables containing date or time columns. The overall objective is to choose a time series method that produces a best fit model of past values, by identifying existing patterns in the data and projecting the model into the future to generate the forecast.

The following methods can be used to forecast future values:

- If the time series is relatively stationary with no overall tendency to fluctuate at one part of the series as compared to another part of the series, then Moving Average, Weighted Moving Average, or Single Exponential Smoothing provide the best fit model.
- If the time series has a trend with a consistent upward or downward movement over time, then Double Exponential Smoothing provide the best fit model.
- If the series has a trend and seasonality with a pattern of peaks and troughs that repeat themselves over a time-frame of usually less than or equal to a year, then Holt-Winters method provide the best fit model.
- If the series has a trend, seasonality and cyclicity with a pattern of peaks and troughs that repeat themselves over an extended time-frame usually greater than a year, then the Multiplicative Decomposition method provide the best fit model.

- If the series displays none of the above, then Neural Networks be used to mathematically fit the historical data.
- If there are theoretical reasons to indicate that the data should follow a clear mathematical function, then one of the Curve fitting methods can be used.

In addition to the above methods, the forecaster is also able to manually adjust any predicted values based on the forecaster's knowledge and any external events.

As most new users discover, the ability to quickly plot and compare each forecast method is a major feature of QMF forecasts. However, a forecaster's knowledge and experience help to reduce the possibilities and consequently provide greater confidence and reliability in the forecast.

## Statistics and forecasts

QMF Analytics for TSO includes statistical analysis and forecasting capabilities that you can run against query results in the TSO environment. You can take the output of a statistical analysis or forecast, such as a graph, a chart, or a table of data, and use it as a means to visualize, validate, and understand the patterns behind your data.

The formulas and calculations associated with statistical analysis and forecasting can be complex. As a business user, you might think that the benefits provided by statistical analysis and forecasting are outweighed by the time and effort required to make successful use of them. But QMF Analytics for TSO provides quick-to-use statistics for business professionals, as well as powerful statistical analysis and forecasting capabilities for the experienced statisticians.

QMF Analytics for TSO applies forecasting techniques such as Box-Jenkins modeling, exponential smoothing, moving averages, regression analysis, and trend projection.

---

## Dashboards and visual applications

A *dashboard* is an interface that integrates data from a variety of sources and provides a unified display of relevant contextual information. *Visual applications* extend the functionality of dashboards with concurrent development support and additional Flash-only objects that are not available with dashboards.

Unlike reports, which usually contain a fixed amount of information, dashboards and visual applications have the capability to deliver real-time information on demand, as needed by the user.

For example, an executive might need to see an operational summary across all business units. Real-time color coding of data (for example, red, yellow, and green) can be used to draw the executive's attention to areas of concern. Clicking on problematic areas immediately produces dynamic reports that reveal the information underlying each area of concern.

Dashboards can present both interactive and persistent data. They are typically designed to run interactively, but are not required to do so. The data that is presented in a dashboard can be obtained from querying multiple data sources across the enterprise and displaying it in a wide range of visual images, including graphs, maps, charts, and custom graphics.

You design dashboards using the visual designer in QMF for Workstation, which allows you to get started in a few simple steps:

1. Drag a dashboard object from the graphical palette and arrange it on the dashboard canvas.
2. Set appearance and font by using the **Properties** view.
3. Add queries and graphical objects (such as date selectors and charts) to your dashboard and define relationships between these objects by graphically wiring the objects together and specifying their relationships.

All elements that can be used in visual reports can be used to create a dashboard as well. The following figure shows the dashboard design environment:

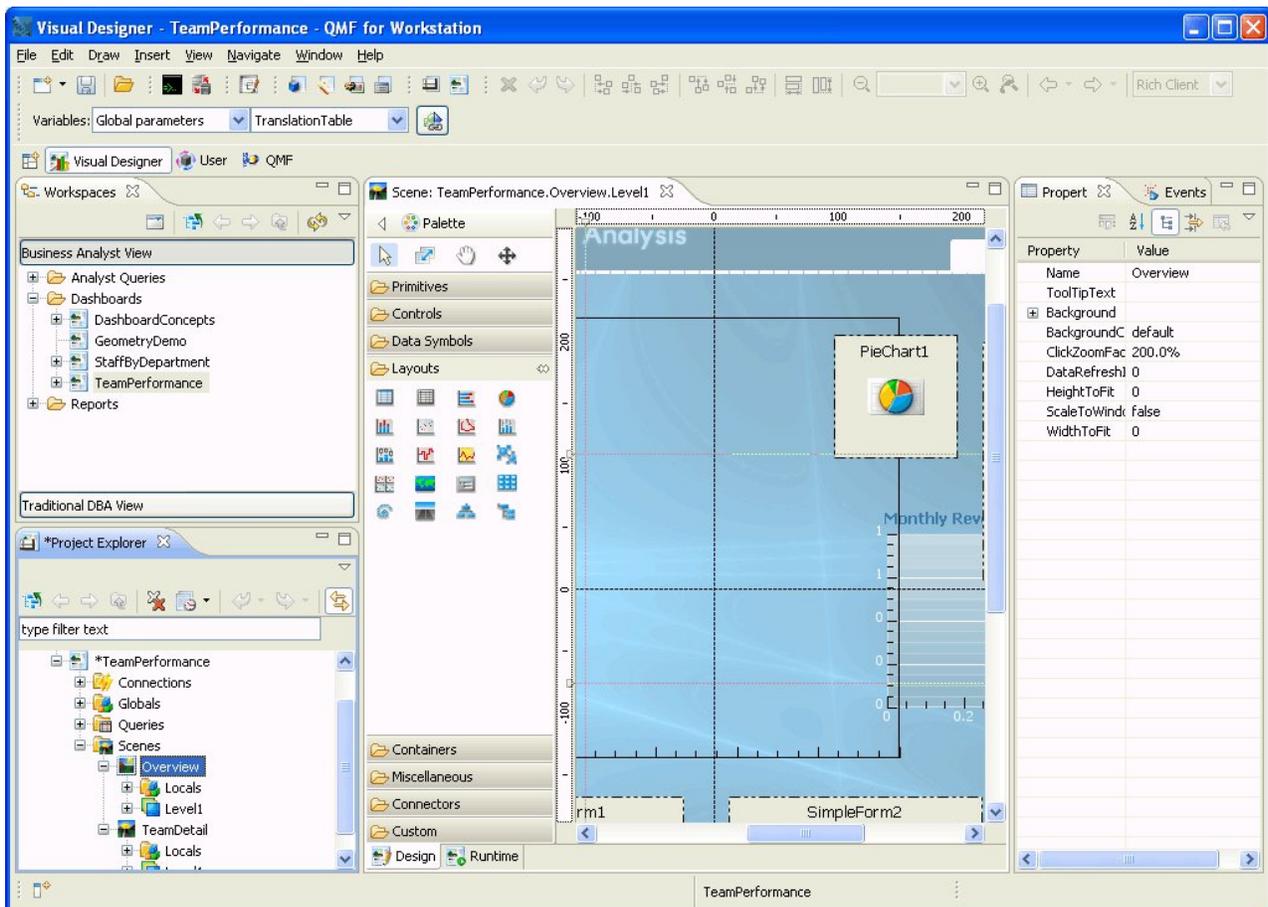


Figure 17. The dashboard design environment in QMF for Workstation

As you create your dashboard, QMF provides built-in ways to:

### Display query results

You use layout objects or control objects such as the List and Combo controls to display query results. You can explore the different display options and decide which options best suit the kind of analysis you want to show.

### Capture user input

You can capture user preferences by using standard user interface controls.

### Pass information to and from the dashboard

You can use parameters to pass information that has been acquired from user actions. This information can then be used to tailor the information displayed within the dashboard.

### Implement navigation features

You can use navigation features to allow users to move around the dashboard to get to new information.

### Display and present information visually

You can drag and drop visual elements on the dashboard canvas and define relationships between them.

### Point to data sources

As you create your dashboard, you specify the data sources that are referenced in the queries that your dashboard uses.

After you create a dashboard, it can be viewed in both QMF for Workstation and QMF for WebSphere applications. The runtime view of a dashboard that is currently being designed is shown in the following figure:

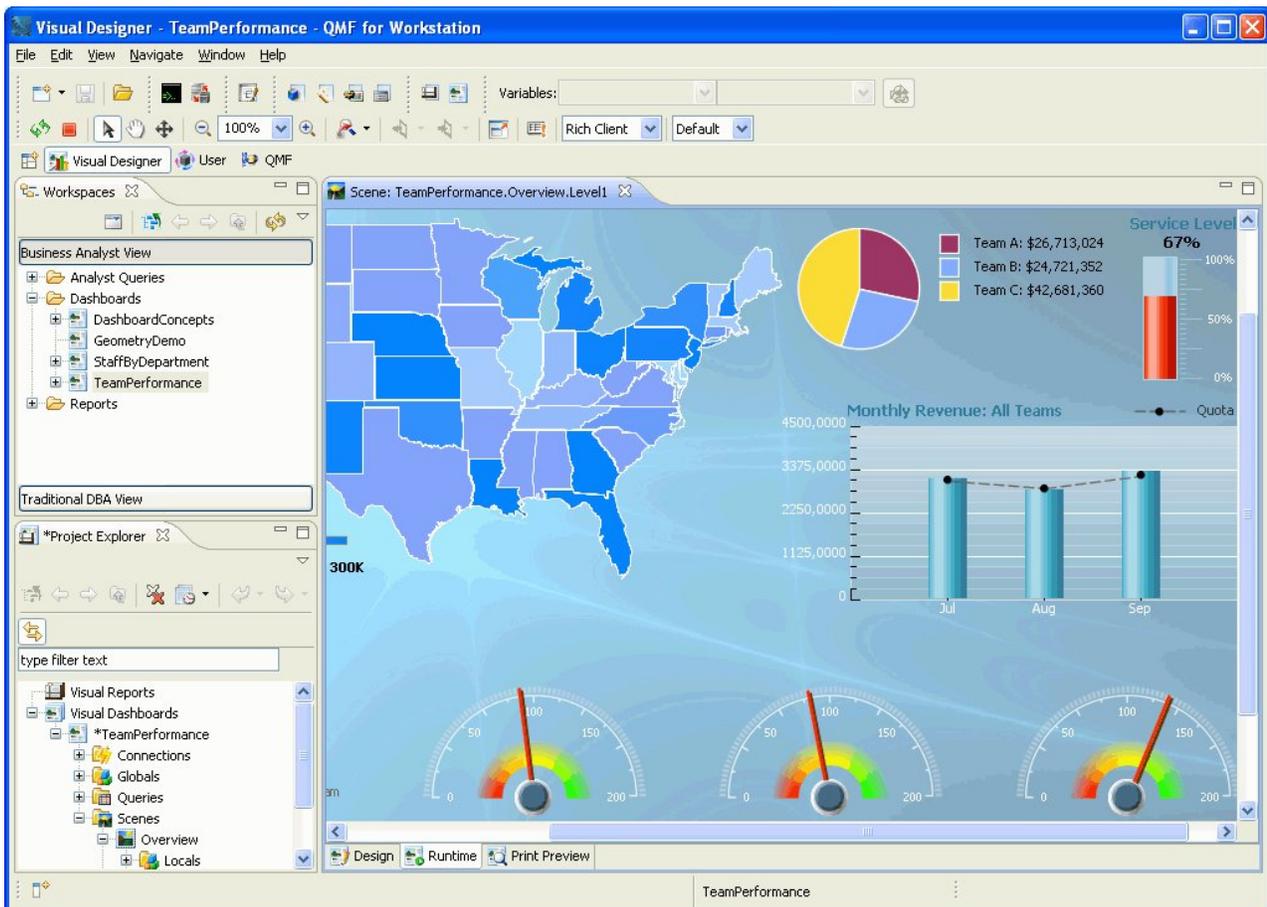


Figure 18. Runtime view of a dashboard that is currently being designed in QMF for Workstation

---

## Analytical functions

Report formatting and presentation alone mean nothing unless you are able to extract meaningful insight from your data. The analysis capabilities in QMF for Workstation go beyond traditional reporting to help you truly gain the insight that you need to drive your organization forward.

A repertoire of over 140 built-in functions allows you to tailor reports and dashboards at an extremely detailed level. Types of built-in functions supported include:

### **Arithmetic functions**

Calculate values based on the specified function

### **Color functions**

Help you customize visual presentation of reports and dashboard objects

### **Conversion functions**

Convert the parameter value from its current data type to another data type

### **Data formatting functions**

Reformat data values to and from database and operating system formats

### **Date and time functions**

Return specific elements of date and time values

### **Hierarchical functions**

Identify a parameter value's position in hierarchical representations such as organization charts

### **Information functions**

Return information on specified data objects

### **Logical functions**

Return values based on logical operations performed on parameter values

### **Math and trigonometric functions**

Calculate values based on the specified mathematical function

### **Measured functions**

Express a given value as a specified unit of measure

### **Security function**

Specifies the name of the security list that will be used to tailor visual report or visual dashboard content based on the security level of the user

### **Spatial functions**

Used when mapping spatial data

### **Statistical functions**

Used to perform standard statistical analysis on supplied parameter values

### **Text functions**

Format and manipulate textual data or return specific information on supplied data sources



## Chapter 4. Data editing capabilities

DB2 QMF for TSO and CICS and DB2 QMF for Workstation both include a table editing interface that allows users to easily and intuitively update data in database tables.

In QMF for Workstation, you can select a table from your workspace, then insert or delete rows or update specific columns or entire rows.

The following figure shows the table editing interface in QMF for Workstation.

1	2	3	4	5	6	7
ID	NAME	DEPT	JOB	YEARS	SALARY	COMM
1	10 SANDERS	20	MGR	7	18357.50	<NULL>
2	20 PERNAL	20	SALES	8	18171.25	612.45
3	30 MARENGHI	38	MGR	5	17506.75	<NULL>
4	40 O'BRIEN	38	SALES	6	18006.00	846.55
5	50 HANES	15	MGR	10	20659.80	<NULL>
6	60 CHUCLEY	38	SALES	5	16808.30	650.25
7	70 MAN	15	SALES	7	16502.83	1152.00
8	80	20	CLERK	6	13504.60	128.20
9	90 TZ	42	SALES	6	18001.75	1386.70
10	100 PLOTZ	42	MGR	7	18352.80	<NULL>
11	110 NGAN	15	CLERK	5	12508.20	206.60
12	120 NAUGHTON	38	CLERK	12	12954.75	180.00
13	130 YAMAGUCHI	42	CLERK	6	10505.90	75.60
14	140 FRAYE	51	MGR	6	21150.00	<NULL>
15	150 WILLIAMS	51	SALES	6	19456.50	637.65
16	160 MOLINARE	10	MGR	7	22959.20	<NULL>
17	170 KERMISCH	15	CLERK	4	12258.50	110.10
18	180 ABRAHAMS	38	CLERK	3	12009.75	236.50
19	190 SNEIDER	20	CLERK	8	14252.75	126.50
20	200 SCOUTTEN	42	CLERK	11	11508.60	84.20
21	210 LU	10	MGR	10	20010.00	<NULL>
22	220 SMITH	51	SALES	7	17654.50	992.80
23	230 LUNDQUIST	51	CLERK	3	13369.80	189.65
24	240 DANIELS	10	MGR	5	19260.25	<NULL>
25	250 WHEELER	51	CLERK	6	14460.00	513.30
26	260 JONES	10	MGR	12	21224.00	<NULL>

Figure 19. The table editing interface in QMF for Workstation

In QMF for TSO and CICS, you can use the Table Editor to edit individual rows or sets of rows that meet certain criteria. The Table Editor has three modes:

### SEARCH

Allows you to search for the row or set of rows that you want to change

**ADD** Allows you to insert rows into the table

### CHANGE

Allows you to update or delete rows in the table

The following figure shows the ADD panel of the Table Editor, with a row being inserted into a table named SUPPLIERS, owned by user KRISTI.

ADD		KRISTI.SUPPLIERS	1 to 7 of 7
ACCTNO. . . . .	(_15002_)		
COMPANY . . . . .	(_S & J Supply Co._____)		
STREET. . . . .	(_948 C Street_____)		
CITY. . . . .	(_Boston_____)		
STATE . . . . .	(_MA_)		
ZIP . . . . .	(_02297_)		
NOTES . . . . .	(_----->		

Figure 20. ADD panel of the Table Editor in QMF for TSO and CICS

Editing data is as easy as typing over the values on the Table Editor panel while you are in Change mode and pressing the Change key. In both Add and Change mode, you can choose to apply your edits immediately or batch multiple edits into a single transaction.

Default confirmation panels help to ensure security and integrity by prompting the user before making any updates final. You can set global variables that control the types of updates for which the confirmation panels are displayed. For extra security, you can also use column-level authorization to control exactly which columns of a table a user can view or change.

---

## Chapter 5. Application development interfaces

QMF provides the capability to seamlessly incorporate product functions and features into your business applications. Both QMF for TSO and CICS and QMF for Workstation and WebSphere offer application programming interfaces.

In addition to application programming with QMF, you can also write sophisticated procedures on any QMF platform.

---

### Interfaces to QMF for TSO and CICS

QMF for TSO and CICS provides several ways to integrate QMF functions seamlessly into existing applications.

#### Stored procedure interface to QMF for TSO

The stored procedure interface to QMF for TSO allows any software program that can call a DB2 for z/OS stored procedure, such as QMF for Workstation and WebSphere, to start QMF for TSO, run a predefined QMF query or procedure, and receive up to 20 reports back as result sets. This interface allows users who might be unfamiliar with QMF for TSO to do meaningful work with the program and provides seamless access to features and resources that might exist only on the system where QMF for TSO is running. Network traffic, and therefore processor time and total cost of ownership, are kept to a minimum because send and receive operations are reduced to a single CALL and return. The interface is made available through a REXX stored procedure that must run in a WLM-managed address space.

To start QMF for TSO as a stored procedure, you issue a CALL statement with predefined syntax. Input parameters passed on the CALL statement include the name of a QMF query or procedure that performs the required QMF tasks, as well as trace settings and the national language in which you want QMF for TSO to run. QMF authenticates the authorization ID under which the WLM-managed address space was started, then runs the query or procedure and returns the required output. The query or procedure that runs after QMF starts must exist in the QMF object catalog on the DB2 for z/OS subsystem in which the stored procedure interface was installed. QMF returns any messages from the stored procedure run in an output parameter.

Similar to QMF for TSO batch mode, the stored procedure interface runs the query or procedure noninteractively, allowing users to multitask. A procedure that is passed to the stored procedure interface can also be used to start a batch job. This capability allows any DB2 client that can issue a CALL statement to access QMF for TSO batch services.

#### Callable interface

You can build sophisticated application suites by using the QMF callable interface and a variety of supported programming languages.

The callable interface lets you integrate QMF functions into ISPF applications or applications written in any of the following programming languages:

- C
- COBOL
- FORTRAN
- High-Level Assembler
- PL/I
- REXX

For example, a REXX program can initiate a QMF session through the callable interface. By directing commands to QMF for execution, the REXX program can run queries, create reports, export and import data, or start an interactive table editing session with QMF's Table Editor. The REXX program can then end the QMF session and continue processing the information. REXX is also available for use in QMF forms and procedures.

Using the callable interface, you can also start an application from within an existing QMF session. Your application can run QMF commands, queries, or procedures and retrieve the results. For example, your application could generate a letter to each employee that is based on a combination of job type and years of service.

### Command interface

The command interface allows you to use QMF services from an Interactive System Productivity Facility (ISPF) dialog. You can integrate QMF for TSO and CICS functions within ISPF dialogs so that users see only ISPF menus.

---

## Interfaces to QMF for Workstation and WebSphere

You can incorporate QMF for Workstation and QMF for WebSphere functions into your business applications in several ways.

- Use QMF for WebSphere to embed queries, reports, and dashboards within Web applications, portlets, or custom Web pages.
- Use Java™ APIs and Web service APIs to incorporate QMF for Workstation features into Java-based workstation and Web applications.
- Automate QMF for Workstation functions by using the Command Library Interface, which provides a way to perform operations outside of the QMF user interface. For example, you could create an external, custom application that generates and exports reports. You can use the Command Library Interface to batch query and report operations, saving time and resources.

---

## Using procedures as applications

A *procedure* is an object that enables you to perform multiple QMF tasks with a single RUN command. Procedures can take advantage of sophisticated data and object management and can help you make more efficient use of resources.

Both QMF for TSO and CICSQMF for TSO and CICS and QMF for Workstation and WebSphere offer procedures.

### Procedures in QMF for TSO and CICS

Linear procedures and procedures with logic provide two ways to run a series of instructions in QMF for TSO and CICS. Linear procedures are available in both TSO and CICS environments and contain only QMF commands.

Procedures with logic are available in QMF for TSO and allow you to include REXX logic in addition to QMF commands. The following figure shows an example of a QMF procedure with logic.

```
PROC                                MODIFIED   LINE    1

/* This procedure checks to see what day it is.  If it's
Monday, it runs a query and prints a report.  If it
isn't, a message is displayed informing the user.  */
signal on error
if date('w') = 'Monday' then
do
  "RUN QUERY MYQUERY (FORM = MYFORM"
  "PRINT REPORT"
  "MESSAGE (TEXT='OK, MONDAY report has been created and sent to printer.'"
end
else
do
  "MESSAGE (TEXT='Sorry, it is not Monday.  Report cannot be created.'"
end
exit 0      /*Exit without errors */
error:
  "MESSAGE (TEXT = '"dsq_message_text'"
  exit 8    /*Exit with error condition*/
*** END ***
```

Figure 21. An example of a procedure with logic in QMF for TSO

Procedures with logic can include any REXX command or function and can also make calls to the operating system or other available environments. In a procedure with logic, you can use conditional formatting, make calculations, or pass commands back to the host environment. You can include both QMF and REXX variables, making the behavior of the procedure data-dependent without rewriting it. You can assign new values to the variables by entering values on the RUN command when the procedure is started or by prompting the user for values using REXX say and pull statements.

QMF provides a special procedure, called a system initialization procedure, that allows you to customize QMF parameters, variables, and session preferences at startup time. You can include any QMF command in the system initialization procedure, allowing you to tailor the QMF session to the operational needs of individual users or groups of users.

In addition to QMF procedures, you can also develop DB2 stored procedures that you can run with a CALL statement on the SQL Query panel in QMF for TSO and CICS. DB2 QMF High Performance Option (HPO) also provides a stored procedure environment.

## Procedures in QMF for Workstation and WebSphere

QMF for Workstation provides built-in procedure development capabilities.

For example, procedures can:

- Run queries
- Print reports
- Import data
- Export data
- Perform other functions

You can create, edit, and run procedures from both QMF for Workstation and QMF for WebSphere. Like other QMF for Workstation objects, procedures are stored in the repository and are accessible through the QMF for Workstation workspaces.

In QMF for Workstation procedures, you can use Open Object Rexx to handle simple and complex calculations, logic, column definitions, detail variations, and conditions. Open Object Rexx is designed for ease of learning and use and helps to make programming accessible to non-programmers. It offers:

- Powerful character manipulation
- Automatic data typing
- Manipulation of words, numbers, and names
- Debugging capabilities

Open Object Rexx functions have the following syntax:

```
function-name ([[expression] [,] [expression] [,] ...])
```

In this syntax, zero to *n* expression arguments can exist (where *n* is the maximum number of comma-separated expressions allowed by Open Object Rexx).

Open Object Rexx is a prerequisite for REXX support in procedures that run in the QMF for Workstation environment.

**Related reference:**



Open Object Rexx

Search for information about downloading Open Object Rexx.

---

## Chapter 6. Performance and resource control

The QMF product family is designed to handle the throughput of the zSeries platform and can handle very large amounts of data. Built-in governing functions help you ensure that resource loads remain within defined parameters as data flow scales to handle greater operational demands.

Built-in and user-defined QMF resource limits help you manage resource consumption. By setting resource limits, you can control a user's access to data sources.

In QMF for Workstation and QMF for WebSphere, you implement resource limits for users by using the administrative interface of either application. The resource limits implemented in either interface apply to all users of both QMF for Workstation and QMF for WebSphere.

In QMF for TSO and CICS, you implement resource limits by using built-in governor logic or the DB2QMF HPO/Manager.

Both the built-in governor logic in QMF for TSO and CICS as well as the governing functions available in QMF for HPO can be used in conjunction with the DB2 resource limit facility.

---

### Monitoring and governing QMF activity with QMF HPO/Manager

QMF HPO/Manager is a family of utilities for managing and administering QMF for TSO and CICS operations.

The QMF HPO/Manager comprises the following integrated components:

- Governor module
- Activity log
- Online facilities

#### Governor module

This module replaces the default governor exit routine provided with QMF for TSO and CICS and is the direct interface to QMF processing for the QMF HPO/Manager. This enhanced governor module is more than a QMF governor because it services the following facilities:

- Object manager

The object manager tracks QMF session activity. It records information about the commands and objects and writes this information directly to the activity log.

You can also produce lists of QMF objects that are based on the content of a specific object. The object manager has a list filter that allows you to locate queries that contain references to specific table names, column names, SQL verbs, and so on. The object manager supports the migration and copying of objects to and from QMF for TSO and CICS. It recognizes and appropriately handles columns in the QMF for TSO/CICS Q.OBJECT\_DIRECTORY table.

- Governor

The governor controls QMF session activity. It obtains thresholds and controls from resource groups in the same way as the QMF for TSO and CICS default governor, but provides a wider and more flexible set of controls. These controls enforce the proper use of resources in QMF sessions operating under TSO and CICS.

- Monitor

The monitor supplies a real-time user interface to information about QMF session activity in TSO and CICS. It accepts administrator commands and passes them to the HPO governor module.

- Query analyzer

The query analyzer provides preemptive governing capabilities. It traps queries before DB2 processes them and estimates their resource consumption. The query analyzer can cancel queries that are estimated to be too resource-intensive.

### Activity log

The activity log provides a repository for QMF session activity and QMF object usage information. The governor module writes directly to the activity log data sets. You must run a batch job periodically to copy the activity log data sets to the activity log tables. You can use the activity log's JCL function to create the JCL to run this batch job.

### Online facilities

The online facilities help organize and simplify the administration and management of QMF HPO. You can review and manipulate QMF for TSO and CICS objects by using the object manager's online facilities. Two types of actions are supported: those that operate on one object and those that can operate on a set of objects.

The QMF HPO/Manager helps you isolate production applications from query and reporting activities. A session activity list (shown in the following figure) gives administrators essential facts about database activity, the number of rows that are fetched, and processor time consumption.

```
DB2A -- Session Activity List -----ROW 1 TO 5 OF 5
COMMAND ==>                               SCROLL ==> CSR
RAAM018I--monitor data refreshed
Valid Actions Are...
B  Browse SQL Text
C  Cancel Current Action
rows that are fetched
TSOID : VNRSTRW
Mode : ONLINE

```

A	Date	Time	Act	Owner	QMF Object	Object	Rows	CPU	C	S
									A	Q
									N	L
	05/09/10	07:47:52	BEG				0		0	
	05/09/10	07:47:52	RUN	VNRSTRW	MODELING		0		0	
	05/09/10	07:48:01	***	VNRSTRW	MODELING		100 00 00 00 23	0	Y	
	05/09/10	07:48:01	***	VNRSTRW	MODELING		1733 00 00 03 69	0		
	05/09/10	07:48:01	***	VNRSTRW	MODELING		3330 00:00:07:20	0		

```
***** BOTTOM OF DATA *****
```

Figure 22. A typical session activity list in the QMF HPO/Manager

Using the QMF HPO/Manager session activity list, QMF administrators can browse the SQL text associated with a query or cancel an active QMF command that is associated with database activity.

---

## Optimizing resource-intensive operations with QMF HPO/Compiler

QMF HPO/Compiler provides utilities for generating, preparing, and running report programs for QMF.

The QMF HPO/Compiler performs these tasks:

- Provides a stored-procedure development environment to create stored procedures
- Reduces resource contention by optimizing resource-intensive queries, forms, and procedures
- Converts dynamic SQL to static SQL, which helps reduce DB2 catalog contention and DB2 optimization overhead

The compiled applications run faster and more efficiently, lowering your production costs.

- Converts queries, reports, and procedures into efficient COBOL programs, generating structured, stand-alone, documented source code that is easy to modify and portable to other platforms

Using a COBOL precompiler, you can run the program on a personal workstation for use with DB2 for Linux, UNIX, and Windows or other database management systems.

The QMF HPO/Compiler contains a program generator and an end-user facility.

### **Program generator**

The program generator is used by programmers to convert QMF reports (queries, forms, and procedures) into compiled programs. In addition, this facility can automatically register report programs with the end-user facility.

CICS programs are pseudo-conversational: they appear to the user as a continuous conversation, but actually consist of multiple tasks. As with TSO programs, you can generate two types of CICS programs: display programs and print programs.

### **End-user facility**

The end-user facility is used to run compiled report programs. When programs are generated and prepared for running, they are automatically registered with the end-user facility. After programs are registered, the nontechnical user interface makes it easy to list, locate, and process reports.

After selecting a report, you are prompted to supply any runtime variable values. If the report will run in batch mode, JCL is automatically generated and optionally submitted. Otherwise, the interactive report is run online in the appropriate environment, TSO or CICS.



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## Chapter 7. Portability and multiplatform access

QMF provides features that help you make your business data portable wherever you need it.

---

### Object portability

You can export query results and other objects from QMF for TSO and CICS and from QMF for Workstation and Websphere.

In QMF for TSO and CICS, you can export QMF queries, query results, procedures, forms, and tables from QMF to TSO data sets or CICS data queues. You can also create or modify objects outside of QMF and import them.

Reports can be exported in HTML format for fast and easy deployment to the Web. QMF adds an HTML header and inserts tags to display the report in its original QMF format in the Web browser. HTML reports are useful when working with LOB data.

Data and tables can be exported either from temporary storage or from the database in the following formats:

- A QMF proprietary format
- IXF format
- XML format
- CSV format

In QMF for Workstation and WebSphere, you can e-mail query results directly from the **File** menu. You can also export results to a database or file in one of the following formats:

- HTML
- PDF
- CSV
- IXF
- dBase III
- XML
- WQML
- TXT
- XLS

Visual reports and dashboards can be deployed in PDF, HTML, or Flash formats in both QMF for Workstation and QMF for WebSphere. With the advantages of a thin-client deployment model, QMF for WebSphere is the perfect vehicle for viewing reports. You can distribute visually rich projects by simply providing access to a single URL.

#### **Related concepts:**

 Exporting and importing objects

You can export data and table objects in either the QMF, IXF, or XML format. Form, prompted query, and report objects are exported in encoded format. Charts

are exported in Graphics Data Format (GDF), a GDDM format.

---

## Multiplatform access

QMF offers platform-independent data access that helps you to get the most out of your investment no matter where your data is stored.

### QMF for TSO and CICS

QMF for TSO and CICS allows you to configure access to any database in the IBM DB2 family.

When you start QMF for TSO and CICS, the system from which you start QMF is known as the *local* system. The DB2 database that resides on this system, where QMF is installed, is known as the *local database*. You can access objects that are stored in databases other than the local database in two ways in QMF for TSO and CICS:

- Use the QMF CONNECT command to connect to the remote database. This method is known as *remote unit of work*.

Remote-unit-of-work connections can be initiated and accepted by QMF running on any of the following types of databases:

- DB2 for z/OS
- DB2 for Linux, UNIX, and Windows
- DB2 for iSeries
- DB2 for VSE and VM

After the connection has been made, you can access and use data as well as QMF objects (queries, procedures, forms, analytics, and folder objects) at the remote database in the same way as you would work with them locally.

The DSQSDBNM program parameter, which you specify when you start QMF, allows you to connect to a remote database before the QMF home panel is displayed so that users do not have to issue the CONNECT command themselves.

- While using QMF on the system where you started the program, issue a QMF command that refers to a table or view by a three-part name that references the name of the remote database in which the data is stored. This method of access is known as *distributed unit of work*.

Three-part names cannot refer to QMF queries, procedures, forms, analytics, and folder objects that are stored in a remote database. To access these objects in a remote database, you must use the CONNECT command or the DSQSDBNM program parameter.

Installation paths specify how to prepare a remote server for either remote unit of work or distributed unit of work access. Using either of these data access methods or a combination of the two, you can use QMF for TSO and CICS to seamlessly access data on any remote DB2 server anywhere in the world, giving your business a global edge.

### QMF for Workstation

After you install QMF for Workstation, you create and populate a centralized repository. The repository contains all information necessary to connect users to data sources and perform query and reporting functions. Users can save their objects in the repository as well.

You can configure QMF access to the following types of relational and multidimensional data sources:

- DB2 running on any platform
- Informix®
- OLAP services included in DB2 Data Warehouse Edition Version 9 or later (all editions)
- Other MDX-based OLAP servers that support XMLA connectivity
- Virtually all other JDBC-compliant data sources, including Oracle and SQL Server

Data access can be shared, personal, network-based, or Web-service-based.

Support for JDBC-compliant data sources includes support for all JDBC-level data types.

Configuring access to a data source involves the following steps:

1. Specify the location and type of JDBC driver that will be used to access the data source.
2. Specify the connection details appropriate for the data source being accessed (such as the host name, TCP/IP port, and database name).
3. Optionally configure permissions and resource limits to be applied when users access the data source.

The QMF for Workstation Administrator perspective makes these tasks efficient by providing wizards that help you to create the repository and configure each data source.

Data sources in the repository can be configured to access the QMF for TSO and CICS object catalog, allowing users to access any objects that are saved in the catalog and save any new objects to the catalog.

## QMF for WebSphere

QMF for WebSphere supports any Web application server (on any platform) that is capable of hosting Java-based Web applications deployed through the use of EAR or WAR files.

QMF for WebSphere can be accessed by virtually any JavaScript-capable Web browser running on any platform, and has been formally validated against the following browsers:

- Microsoft Internet Explorer Version 7 (or later)
- Mozilla Firefox Version 3.0 (or later)



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## Chapter 8. Ease of use and administration

The QMF product family provides several features that make QMF easy to deploy, use, and maintain.

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### Straightforward navigation and object design

QMF for Workstation offers an extremely intuitive, graphical drag-and-drop design environment for visual reports and dashboards.

For example, the graphical query diagram view allows less-experienced users to join tables by dragging and dropping related columns, effectively "wiring" them together. The OLAP query designer allows you to drag and drop dimensions and measures of interest into queries and immediately see the results of those selections. Online assistance is available to help users create SQL and OLAP queries.

After the query is run, query results can be manipulated using a drag-and-drop, fully interactive data-analysis grid. This grid supports adding calculated columns (for example, adding a Total column that sums three columns in the query results). You can also use the grid to rearrange columns and group and aggregate the data, including using pivot functions.

Selecting from the graphical palette, you can also drag and drop charts, graphs, selectors, and other graphical elements onto the canvas and wire data to them, as appropriate. You can then size and position each element and manipulate properties such as format, color, and options. This capability allows you to customize items such as fonts, legends, and logos.

Clicked items carry their full context to the destination object or page. For example, by clicking on a pie slice that is embedded in a bar chart embedded on a regional map, data that characterizes region, sales month, and product ID can be automatically transferred to the destination object or page. After the data is transferred to the object or page, that data can be used to drive the drill-down charts and graphs that provide more information about the item. All graphical entities can be assigned drill-down actions so that you can customize what a particular part of a visual report or dashboard will do when it is clicked or dragged.

The Web client and desktop client environments share a common look and feel, which allows users to move from one interface to the other easily and reduces the need for additional training and its associated time and expense.

Navigation between queries, forms, procedures, and reports is quick and easy in QMF for TSO and CICS as well. The following temporary storage areas store objects while you work on them. You can quickly and easily navigate between the temporary storage areas by issuing the SHOW command, followed by the name of the temporary storage area.

#### **QUERY**

Stores queries

**DATA** Stores query results

**REPORT**

Stores query results as formatted by the report formatting specifications that are currently in the FORM temporary storage area

**FORM**

Stores report formatting specifications

To navigate to different parts of the form object, you can issue the SHOW command followed by the name of the form panel that you want to see.

**CHART**

Stores query results as formatted by the chart formatting specifications that are currently in the FORM temporary storage area

**PROC** Stores procedures

**PROFILE**

Stores specifications and preferences for aspects of a user's QMF session

QMF for TSO and CICS also provides a straightforward, iterative design environment for reports. The RUN QUERY command returns query results; users can then issue various SHOW FORM commands to display a set of default formatting specifications for each area of the report, then iteratively build on these specifications until the report is final.

**Related concepts:**

"Tabular reports" on page 24

Tabular reports in QMF for Workstation provide users with the capability to formulate and present raw data from query results in a tabular report. The design interface includes a Design view for designing and structuring report data and a Runtime view for viewing how the report output is displayed.

---

## Role-based user interfaces

QMF for Workstation is specifically designed to accommodate the roles that are found in organizations that rely on business intelligence software. *Perspectives* provide the views, menus, and wizards that are commonly used by a particular type of business intelligence user.

The following perspectives are available:

**Administrator**

The Administrator perspective provides the views, menus, and wizards that enable a user with administrative privileges to create and maintain repositories.

**Visual Designer**

The Visual Designer perspective provides the views, menus, and wizards that are used to create visual reports and dashboards.

**User** The User perspective provides the views, menus, and wizards that are used to query data sources, access or construct reports, and view dashboards.

**QMF** The QMF perspective replicates the look and feel of QMF for Windows Version 8.

Users can switch between the four different perspectives according to how their security privileges are set.

In QMF for TSO and CICS, administrators control access to objects by granting SQL authorities and privileges for specific objects as necessary. Function keys and commands can be customized by user or group role; these definitions can then be referenced by each user's QMF profile during initialization so that the customized interface displays when the QMF session starts.

---

## Virtual data sources that shield end users from complexity

Virtual data sources in QMF for Workstation and WebSphere allow administrators to optionally shield their users from the complexities of the underlying database structures, providing content designers with a simplified data model against which content can be created.

Virtual data sources work by introducing a metadata layer that mediates between an administrator-defined, virtual data source and the underlying data sources that contain the physical tables and views. This streamlines the design process by replacing obscure column names with easy-to-understand alternatives and representing complex table joins as a single virtual table.

Administrators can define multiple virtual tables in a single virtual database, each of which draws data from one or more tables within differing data sources. To users, a virtual data source acts as a single database, allowing users to write queries against all tables contained within it, despite the fact that their underlying data resides in different data sources. Virtual data sources also insulate users from database schema changes, allowing database administrators to make changes to the underlying database schemas without affecting existing dashboards, queries, or reports.

---

## Ability to customize the work environment

With QMF, you get all the business intelligence functions you need without sacrificing the ability to customize and tailor that function precisely to your operational needs. Both QMF for TSO and CICS and QMF for Workstation and WebSphere offer the ability to customize product functions and the user's work environment.

### Customizing QMF for TSO and CICS

There are many ways to customize functions and preferences in QMF for TSO and CICS.

For example, you can:

- Create QMF profiles for individual users or groups of users, which control preferences for printing, query interfaces, and other common QMF functions.
- Create procedures and applications tailored to your specific business needs and then customize both QMF commands and function keys to allow users to run those applications.
- Use QMF program parameters and global variables both at startup time and in your business applications to customize settings for storage, tracing, operating mode (interactive or batch), and other aspects of the QMF operating environment.
- Create your own edit codes for QMF forms. These user-defined codes format the data in ways that are defined by an underlying data formatting routine that you create.

## Personalizing preferences for individual users or groups

QMF for TSO and CICS allows you to create QMF profiles for individual users or groups of users.

The QMF profile settings specify preferences for the following QMF functions:

- The case in which input is passed to QMF
- Punctuation format for numeric data on reports
- Whether you want confirmation panels to appear to users before database changes are made
- Which query interface will be used by default
- Printer parameters, such as location and size of output
- The default table space or dbspace that will store the results of QMF SAVE DATA commands
- Tracing options that allow you to choose the functions that you want to trace and the level of detail at which you want to trace them

Users can update some fields of their profiles on their own by issuing the SHOW PROFILE command and typing over the values in the profile fields. Other fields, such as those that record which definitions to use for commands and function keys, are protected and can only be updated with an SQL UPDATE statement on the QMF control table that stores profile information.

## Tailoring commands and function keys to your business applications

With QMF for TSO and CICS, you can customize commands and function keys to provide seamless integration between the QMF interface and applications specific to your business needs and operations.

Customizing commands is as simple as creating a command synonym table in the database, entering execution instructions for those commands into the table, then updating the user's row in the QMF profiles control table to point to the name of the synonyms table.

A command synonym does not have to correspond to a single execution instruction; for example, you might create a command synonym called PRINT that invokes a printing application and routes the output to the appropriate printer with the specified page size and parameters.

After you create command synonyms, you can use the same basic process to assign the synonyms to function keys.

## Customizing the QMF operating environment

QMF offers a broad range of global variables that record state information about the user's QMF session and enable you to customize and control QMF behavior.

You can use several methods to set global variables and other environment settings before QMF starts:

- The DSQUOPTS exit routine provides some initial QMF settings, such as the command or set of commands that causes the LAST\_USED column of the Q.OBJECT\_DIRECTORY table to be updated. You can modify this routine to specify additional environment settings.
- You can use the Q.GLOBAL\_VARS table to define global variable settings that are to be used when QMF starts. This table is automatically created at installation and is required for QMF to start.

- QMF provides a default system initialization procedure that you can run by itself or within an application. The procedure can be customized to run any QMF command or any stored query that the user is authorized to run, prior to displaying the QMF home panel. You can therefore use this procedure to tailor the QMF session to the operational needs of individual users or groups of users.
- You can use a variety of QMF program parameters to customize QMF behavior, report storage, and aspects of the QMF session.

During a QMF session, you can control and check almost any aspect of the session by using the following commands:

- The SET GLOBAL command allows you to dynamically change aspects of the QMF environment as well as to define your own global variables for use in QMF queries, procedures, and forms.
- The SHOW GLOBALS command displays the current values of all QMF and user-defined global variables.

Additionally, you can set the DSQEC\_USERGLV\_SAV global variable to save the values of user-defined global variables and changeable QMF global variables from session to session. By default, the values of global variables that are set during a QMF session are not retained across sessions.

### **Creating your own edit codes for formatting QMF reports**

QMF for TSO and CICS offers a wide range of edit codes in the QMF form panels to help you format the data in individual columns.

If you need additional formatting capability, you also have the option of creating your own edit codes. You create your own edit codes by either customizing the default edit exit routine provided with QMF for TSO and CICS or writing your own routine, which passes information to and from QMF through the edit exit interface control block.

### **Customizing other QMF functions**

QMF for TSO and CICS offers the ability to create end-of-application messages and customized application panels.

QMF for TSO and CICS offers the ability to use the MESSAGE command to define a message that appears on a QMF object panel when your application ends. You can also use ISPF, GDDM, or another panel manager to create customized panels:

- Application panels that run complex queries and produce customized reports
- Panels that prompt users for necessary information, such as date and type of report wanted. The prompts help a user with limited knowledge of QMF to use the query and report-writing facilities of QMF.
- Panels to provide your application with online help that is similar to the help that is provided by QMF for TSO and CICS.

## **Customizing QMF for Workstation and WebSphere**

Administrators and content designers can customize the experience for their information consumers in a number of different ways in QMF for Workstation.

## Customizing content with unlimited design options

The visual design environment in QMF is extremely flexible, allowing users to graphically place charts, selectors, controls, and graphical primitives on the report canvas and embed static content such as text, graphics, hyperlinks, and supporting information (data-driven or static).

With 20 default charts and graphs, over 140 analytical functions, and broad visual palettes of dozens of primitives and other dashboard and report objects, there is much to choose from to accommodate any visual design need.

Designers can nest elements (queries, reports, and dashboards) within each other infinitely, allowing a level of detail that exceeds what would ever be required in an operational environment. The dynamic object properties of QMF also provide full control of the data elements, down to the individual items in charts. Designers can also control the appearance and behavior of these items as a function of the data and user interactions.

## Customizing workspaces by user or role

Users can create and tailor their own workspaces according to their needs and preferences, then share these workspaces with other users according to an administrator-defined set of security permissions. Additionally, all views can be customized based on user or role. Users can define workgroups and publish reports and other objects just to a particular workgroup.

## Customizing dashboard behavior based on security privileges

Dashboards can be personalized by tailoring visibility and behavior of dashboard elements in accordance with the security privileges of the logged-on user.

For example, graphs and charts can be limited to specific users or groups, or fields can be defined as editable by some users or groups, yet read-only for others. Behavior can be modified using simple object property expressions.

---

## Flexible security models

A very robust function set combined with the ability to easily query and format data calls for a highly flexible set of security features that is robust in its own right. A variety of security features are available in QMF.

### Authentication methods

QMF for Workstation uses the industry-standard LDAP protocol for user authentication. You can secure repository content using LDAP-defined or internally-defined user or group directories. QMF for Workstation also supports Active Directory, Microsoft's implementation of the LDAP directory service model.

In QMF for TSO and CICS, users are authenticated through the user IDs stored in the QMF profiles table. You can configure QMF for open authentication, in which users who don't have specific QMF user IDs in the QMF profiles control table can use QMF under a generic user ID, or restricted authentication, in which the user ID used to log onto QMF must match one of the unique IDs stored in the QMF profiles control table.

Additionally, in QMF for TSO, you can choose to have QMF authenticate users by using their database authorization IDs or their TSO logon IDs.

## **Administrator-controlled access**

The QMF for Workstation interface allows you to make as much or as little viewable and available to your users as you want. For example, you can configure QMF to display only those objects for which the user has the appropriate security privileges or limit the display of a database table to a subset of columns that you want the user to see. Users can create and password-protect their own repositories so that they can navigate and easily manage the objects that they are allowed to access. A full range of security permissions (view, view/edit, and view/edit/delete) can be applied to every object in an object repository, including individual columns. For example, permissions can be configured so that a database table might show all columns to a faculty group, yet only show a subset of the columns to a student user group. A report can be structured so that it hides from the student user group a bar chart with cumulative test scores, yet displays it for members of the faculty.

QMF for TSO and CICS also allows great flexibility for configuring access to objects and data. For example, you can create views on tables that screen out sensitive columns or use the SHARE=NO parameter of the SAVE command to restrict sensitive queries, procedures, and forms. You can issue one or more SQL GRANT statements directly from the SQL query panel to grant select, insert, update, or delete privileges on tables or individual columns.

## **Security of Web clients**

The capability of QMF for WebSphere to operate over HTTPS connections ensures that client/server transmissions remain secure in all query, reporting, analysis, and dashboard operations.

## **FIPS 140 compliance**

QMF for Workstation and QMF for WebSphere use the FIPS 140-2 approved cryptographic provider(s); IBMJCEFIPS (certificate 376) and/or IBMJSSEFIPS (certificate 409) and/or IBM Crypto for C (ICC (certificate 384) for cryptography. The certificates are listed on the NIST web site at <http://csrc.nist.gov/cryptval/140-1/1401val2004.htm>.

---

## **Reuse**

The emphasis in QMF on reuse allows you to deploy a consistent look and feel in reporting across your enterprise when you need it, which saves time and reduces your total cost of ownership.

To allow users to spend more time gaining insight from your business data and less time retrieving, formatting, and presenting that data, the queries that retrieve the data and the specifications you use to format that data can be designed as templates that are applied to the data at run time. You can save these templates to a server for indexing and reuse them in different situations. For example, a query that was designed to output the salary history for the sales team can be reused to display salary history for technical support personnel in a different division. The format of the resulting report is not tightly bound to a given entity; it can be used with entirely different queries that retrieve the same types of data.

To allow for even greater flexibility, substitution variables can be used as placeholders that can be replaced with actual values at run time. You can set substitution variables, whose values are used for a particular SQL query at run time, or global variables, which can be set and then used by several objects (for example, queries, reports, or procedures) for the duration of the entire QMF session. In QMF for Workstation and WebSphere, variable values can be set to be retained between sessions or re-initialized to default values, entirely at the discretion of the content creator or administrator.

---

## Scheduling queries, reports, and procedures

Use the scheduled tasks feature to create automated actions such as running queries and exporting query results without taking direct action from the user interface.

Scheduled tasks are invaluable tools that help to automate business processes to run at specified dates and times. This is especially useful for actions that must be run on a regular basis, such as weekly sales reports that are supposed to be distributed to several different locations, or quarterly earnings reports.

In QMF for TSO and CICS, you can use REXX or other application logic to run queries and perform other tasks in QMF batch mode so that resources are kept free during peak hours. You can start QMF batch jobs in multiple ways, including from remote DB2 clients.

Reports in both QMF for Workstation and QMF for WebSphere and QMF for TSO and CICS can be submitted in a variety of ways – on demand, based on a workflow event, according to a predefined schedule, or based on conditional expressions you specify.

---

## Built-in user assistance

Both topic-based and context-sensitive online help are available in all QMF environments. Additionally, wizards in QMF for Workstation and WebSphere guide creation of everything from repositories to individual objects.

Explanations and suggested actions for error messages are available in the online help for QMF for TSO and CICS. For errors associated with database SQL codes, the QMF error message help also displays the contents of the SQL Communications Area (SQLCA) so that you have all the important runtime information you need to help you troubleshoot potential problems.

In all QMF environments, you can optionally install sample tables and queries for use while learning or testing applications so that real-time data on production systems is unaffected by these activities. In addition to sample tables and queries, QMF for Workstation and WebSphere also provide sample reports and dashboards to help users learn how to create these objects. Cheat sheets for key tasks provide step-by-step instructions and make it easy to get started immediately.

## Chapter 9. Multicultural support

Global organizations require products that offer multilingual support for all staff to be as productive as possible.

QMF for TSO and CICS, QMF Analytics for TSO, and QMF for Workstation and WebSphere together support the languages shown in the following figure.



Figure 23. National languages in which QMF is available

### Multicultural support in QMF for TSO and CICS

Software, online help, and publications for QMF for TSO and CICS environments are available in multiple languages.

The software and online help are available in the following languages:

- Brazilian Portuguese
- Danish
- French, Canadian French, and Swiss French
- German and Swiss German
- Italian
- Japanese
- Korean
- Spanish
- Swedish

The publications for QMF for TSO and CICS are available in the following languages.

Table 1. Languages in which the QMF for TSO and CICS publications are available

Publication Title	Brazilian Portuguese	French	German	Japanese	Spanish
Introducing DB2 QMF	X	X	X	X	X

Table 1. Languages in which the QMF for TSO and CICS publications are available (continued)

Publication Title	Brazilian Portuguese	French	German	Japanese	Spanish
<i>Installing and Managing DB2 QMF for TSO and CICS</i>	X	X		X	X
<i>Using DB2 QMF</i>	X	X	X	X	X
<i>DB2 QMF Reference</i>	X	X	X	X	X
<i>Developing DB2 QMF Applications</i>	X	X		X	X
<i>DB2 QMF Messages and Codes</i>	X	X		X	X

For applications that call QMF for TSO and CICS running from an NLF session, bilingual forms and commands are also supported. This feature allows wider portability of forms and applications among the QMF national languages.

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## Multicultural support in QMF Analytics for TSO

Software and online help for QMF Analytics for TSO are available in multiple national languages.

The software and online help are available in the following languages:

- Brazilian Portuguese
- Danish
- French, Canadian French, and Swiss French
- German and Swiss German
- Italian
- Japanese
- Korean
- Spanish
- Swedish

QMF Analytics for TSO does not have its own publications. For information about installing, managing, using, and troubleshooting QMF Analytics for TSO, see the QMF for TSO and CICS publications.

For information about languages in which the QMF for TSO and CICS publications are available, see “Multicultural support in QMF for TSO and CICS” on page 59.

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## Multicultural support in QMF for Workstation and QMF for WebSphere

Software, online help, and publications for QMF for Workstation and QMF for WebSphere are available in multiple languages.

The software and online help are available in the following languages:

- Arabic
- Brazilian Portuguese

- Czech
- Danish
- French, Belgian French, Canadian French, and Swiss French
- German and Swiss German
- Hebrew
- Italian and Swiss Italian
- Japanese
- Korean
- Portuguese
- Spanish
- Swedish
- Traditional Chinese

The publications for QMF for Workstation and WebSphere are available in the following languages.

*Table 2. Languages in which the QMF for Workstation and WebSphere publications are available*

<b>Publication Title</b>	<b>Arabic</b>	<b>Brazilian Portuguese</b>	<b>French</b>	<b>German</b>	<b>Japanese</b>	<b>Portuguese</b>	<b>Spanish</b>	<b>Traditional Chinese</b>
<i>Introducing DB2 QMF</i>		X	X	X	X		X	
Installing and Managing DB2 QMF for Workstation and DB2 QMF for WebSphere		X	X	X	X	X	X	X
Getting Started with DB2 QMF for Workstation and DB2 QMF for WebSphere	X	X	X	X	X	X	X	



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## Appendix A. Accessibility features

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use a software product successfully. Accessibility features are available in QMF in all of its operating environments.

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### QMF for TSO and CICS accessibility features

QMF for TSO and CICS includes several accessibility features.

The accessibility features in QMF for TSO and CICS enable users to:

- Use assistive technologies such as screen readers and screen magnifier software. Consult the assistive technology documentation for specific information when using it to access z/OS interfaces.
- Customize display attributes such as color, contrast, and font size.
- Operate specific or equivalent features by using only the keyboard. Refer to the following publications for information about accessing ISPF interfaces:
  - *z/OS ISPF User's Guide, Volume 1*
  - *z/OS TSO/E Primer*
  - *z/OS TSO/E User's Guide*

These guides describe how to use ISPF, including the use of keyboard shortcuts or function keys (PF keys), include the default settings for the PF keys, and explain how to modify their functions.

---

### QMF Analytics for TSO accessibility features

QMF Analytics for TSO includes accessibility features.

You can operate specific or equivalent features by using only the keyboard.

---

### QMF for Workstation accessibility features

QMF for Workstation includes several accessibility features.

**Note:** The QMF for Workstation application provides the best accessibility functionality. Users with physical disabilities who must make use of the QMF accessibility features should install and run QMF for Workstation, as opposed to QMF for WebSphere.

#### Standard keyboard equivalents

The keyboard is the most frequently used alternative for performing mouse functions. Keyboard equivalents use keyboard keys to perform mouse actions instead of using a mouse. For example, QMF for Workstation supports the following keyboard equivalents:

- Shortcut, or accelerator keys, to perform the most frequently used functions in pull-down menus without going to the menu. For example:
  - Ctrl+S to save
  - Ctrl+P to print
  - Ctrl+R to run a query

Shortcuts display in the pull-down menu next to each function.

- Mnemonics, or access keys, are available to perform each function on a menu or dialog box. A mnemonic for a function is the underlined character in the function name and is used in combination with the Alt key to execute the function. For example:
  - Press Alt then F to open the **F**ile menu
  - Press Alt then O to open the Open dialog box

For more information, refer to the documentation for your operating system for a complete list of standard keyboard equivalents.

## Standard keyboard navigation

*Keyboard navigation* refers to using keys instead of a mouse to move from item to item on your screen. The movement is usually in the order specified by the operating system or your application.

QMF for Workstation follows the standards with regard to the typical keys used for keyboard navigation, such as using the Tab key and Shift+Tab to move between controls, as well as arrow keys to move up, down, and sideways between items.

## Operating system accessibility

Each operating system has a set of accessibility options that enables individuals with disabilities to customize system-wide settings.

QMF for Workstation:

- Inherits settings from the operating system.
- Does not interfere with keyboard accessibility features built into the operating system.

## Assistive technology products

QMF for Workstation supports assistive technology products, such as screen readers and voice synthesizers.

QMF for Workstation requires special navigation when using a screen reader with query results.

## Keyboard shortcuts QMF for Workstation

The following table lists keyboard navigation aids available in QMF for Workstation.

Table 3. Keyboard navigation aids in QMF for Workstation

To...	Do the following...
Obtain online help	Press F1 or Alt+H.  In online help, use the Tab key to navigate from link to link, then press Enter to open the link.
Add object or condition	<ol style="list-style-type: none"><li>1. Press the Tab key to navigate to the pane you need, such as in the Prompted Query dialog box.</li><li>2. Press the Tab key again to get to the <b>Add</b> icon.</li><li>3. Press the spacebar to display the Add dialog box.</li></ol>

Table 3. Keyboard navigation aids in QMF for Workstation (continued)

To...	Do the following...
Select multiple objects	<ol style="list-style-type: none"> <li>1. Press the Tab key to get to the list box.</li> <li>2. Press Shift+Arrow to select rows.</li> <li>3. Press Shift+Enter to add the objects.</li> </ol>
View object properties in an object list	<ol style="list-style-type: none"> <li>1. Select the object from the object list.</li> <li>2. Press Alt+Enter.</li> </ol>
<p>Use screen reader for query results</p> <p>- or -</p> <p>Use browser to display query results in high-contrast mode for the visually impaired</p>	<p>Option 1:</p> <ol style="list-style-type: none"> <li>1. Run the query.</li> <li>2. Press Alt+R to open the Results menu.</li> <li>3. Select <b>Save to File</b>.</li> <li>4. Select HTML file (*.htm) for <b>Save as type</b>.</li> <li>5. Open the *.htm file in browser.</li> </ol> <p>Option 2:</p> <ol style="list-style-type: none"> <li>1. Run the query.</li> <li>2. Press Alt+R to open the <b>Results</b> menu.</li> <li>3. Select <b>Display Report</b>.</li> <li>4. Select the form type.</li> <li>5. Press <b>OK</b>.</li> <li>6. Press Alt+O to open the <b>Form</b> menu.</li> <li>7. Select <b>Convert to HTML form</b>.</li> <li>8. Check the <b>Include tabular data as HTML table</b> check box.</li> <li>9. Press <b>OK</b>.</li> <li>10. Press Alt+O to open the <b>Form</b> menu.</li> <li>11. Select <b>View in Web browser</b>.</li> </ol> <p>Option 3:</p> <ol style="list-style-type: none"> <li>1. Run the query.</li> <li>2. Press Alt+R to open the <b>Results</b> menu.</li> <li>3. Select <b>Save to File</b>.</li> <li>4. Select CSV file (*.csv) for <b>Save as type</b>.</li> <li>5. Open the *.csv file in Microsoft Explorer.</li> </ol>
Edit (editable) rows in list box	<ol style="list-style-type: none"> <li>1. Tab to the list box, such as the Global Variables dialog box.</li> <li>2. Press the spacebar or move the arrow key to select the row.</li> <li>3. Press F2 to activate edit mode.</li> <li>4. Use the Tab key to move between columns and rows.</li> <li>5. Press Enter to accept edits.</li> <li>6. Press the Tab key to exit the listbox and move to the next control in the dialog.</li> </ol>
Edit query results	<ol style="list-style-type: none"> <li>1. Press Alt+E for the <b>Edit</b> menu.</li> <li>2. Select <b>Find</b>. The Find dialog box opens.</li> <li>3. Type the search text.</li> <li>4. Press Enter.</li> <li>5. Press Esc to close the Find dialog box.</li> <li>6. Press Enter to edit the cell.</li> </ol>

Table 3. Keyboard navigation aids in QMF for Workstation (continued)

To...	Do the following...
Change font for query results	<ol style="list-style-type: none"> <li>1. Run the query.</li> <li>2. Press Ctrl+A to select all.</li> <li>3. Press Alt+R to display the <b>Results</b> menu.</li> <li>4. Type F to display the Font dialog box.</li> </ol>

**Related reference:**



IBM Accessibility

See information about operating system accessibility.

## QMF for WebSphere accessibility features

QMF for WebSphere includes several accessibility features.

### Standard keyboard navigation

*Keyboard navigation* refers to using keys instead of a mouse to move from item to item on your screen. The movement is usually in the order specified by the operating system or your application.

QMF for WebSphere follows the standards with regard to the typical keys used for keyboard navigation, such as using the Tab key and Shift+Tab to move between controls, as well as arrow keys to move up, down, and sideways between items.

### Operating system accessibility

Your operating system has a set of accessibility options that enables individuals with disabilities to customize system-wide settings to further enhance and improve their ability to use their computers. QMF for WebSphere inherits and does not interfere with the keyboard accessibility features that are set for the operating system.

### Assistive technology products

QMF for WebSphere supports assistive technology products, such as screen readers and voice synthesizers, to deliver information in a more accessible manner.

### Keyboard shortcuts in QMF for WebSphere

The following table lists keyboard navigation aids that are available in QMF for WebSphere.

Table 4. Keyboard navigation aids in QMF for WebSphere

To...	Do the following...
Move focus through each element	Press the Tab key to move forward or Shift+Tab to move in the opposite direction.
Emulate clicks on a link	Use the Tab key to navigate from link to link, then press Enter.
Emulate clicks on a button	Use the Tab key to navigate from button to button, then press the key.
Within a dialog, activate the default action	Press Enter.
Within a dialog, cancel the action	Press Esc.

Table 4. Keyboard navigation aids in QMF for WebSphere (continued)

To...	Do the following...
Move focus to the command line	Press Alt+C.
Move focus to the main menu	Press the left Alt key. Navigate through the menu commands using the arrow keys.
Open context menus	Press the Context menu key if you have an extended keyboard. You can also press the right Ctrl key to open a context menu. Navigate through the menu commands using the arrow keys.

## Accessibility features for QMF Data Service and QMF Vision

Accessibility features help users with physical disabilities, such as restricted mobility or limited vision, to use software products successfully. The following list specifies the major accessibility features:

- All product functionality is available by using the keyboard for navigation instead of the mouse.
- You can customize the size and color of the fonts of user interfaces.
- This product supports accessibility applications that use the Java Accessibility API.
- Product documentation is provided in an accessible format.

### Keyboard input and navigation

#### Keyboard input

You can operate the this product by using only the keyboard. You can use keys or key combinations to perform operations that can also be done with a mouse. Standard operating system keystrokes are used for standard operating system operations.

#### Keyboard navigation

You can navigate this product's user interface with keys or key combinations.

#### Keyboard focus

In Linux and UNIX operating systems, the area of the active window with focus is highlighted to indicate what input controls your keystrokes will affect.

### Accessible display

This product has features that improve accessibility for users with low vision or other visual impairments. These accessibility enhancements include support for customizable font properties.

#### Font settings

You can select the color, size, and font for the text in menus and dialog windows, by using the Tools Settings notebook.

For more information about specifying font settings, see the related links.

#### Non-dependence on color

You do not need to distinguish between colors to use any of the functions in this product.

## **Compatibility with assistive technologies**

This product's interface supports the Java Accessibility API, which enables you to use screen readers and other assistive technologies.

## **Accessible documentation**

Documentation for this product is provided in XHTML 1.0 format, which is viewable in most web browsers. XHTML allows you to view documentation according to the display preferences set in your browser. It also allows you to use screen readers and other assistive technologies.

---

## Appendix B. Product prerequisites, installation and configuration, and ordering information

You can use this information to help take the next step in assessing QMF components.

### Product prerequisites

For more information about requirements and prerequisites for storage, memory, hardware, and software to support QMF, see the appropriate information source.

- For information about the SMP/E installation of QMF for TSO and CICS, QMF Applications, which includes QMF Analytics for TSO and QMF Enhanced Editor, and QMF High Performance Option, see the Program Directories at <http://www-01.ibm.com/support/docview.wss?uid=swg27021603#qmf11-pd>.
- System requirements for QMF are listed at <http://www-01.ibm.com/support/docview.wss?uid=swg27039374>.

### Installation and configuration information

You can find installation and configuration information for QMF in the following publications:

- For QMF for TSO and CICS and QMF Applications: Installing and Managing DB2 QMF for TSO and CICS
- For QMF for Workstation and QMF for WebSphere: Installing and Managing DB2 QMF for Workstation and DB2 QMF for WebSphere
- For the QMF High Performance Option: QMF HPO User's Guide for TSO and CICS

### Ordering QMF

DB2 QMF for z/OS is sold as a stand-alone DB2 for z/OS tool (5697-QMF). DB2 QMF for z/OS contains: QMF for TSO and CICS, QMF Applications (QMF Analytics for TSO and QMF Enhanced Editor), QMF for Workstation, QMF for WebSphere, and QMF High Performance Option.



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