Using Rational QualityArchitect

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Contents

Preface

This manual provides conceptual information and task-oriented guidelines for using Rational QualityArchitect. QualityArchitect is a collection of integrated tools for testing middleware components built with technologies such as Enterprise JavaBeans and COM.

Audience

This guide is intended for all members of the development team who design, write, or edit test scripts to be used for testing Enterprise JavaBeans and COM components. A solid foundation in the target test script language is assumed.

Other Resources

This guide is available as a printed manual and in electronic form in HTML and PDF.

To access the HTML version:

- Start Rose and click **Tools > Rational Test > Online Manual**.

The PDF version of this manual is available on the *Rational Solutions for Windows* Online Documentation CD.

Context-sensitive online Help is available for QualityArchitect from within Rose.

To access the online Help:

1. Click **Tools > Rational Test > Toolbar**.
2. When the toolbar is displayed, press **F1.**

   The Help will appear after several seconds.

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- Product release number and serial number
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Introduction 1

Rational QualityArchitect is a powerful collection of integrated tools for testing middleware components built with technologies such as Enterprise JavaBeans and COM.

QualityArchitect lets you reverse-engineer a component into Rational Rose, generate test scripts, and finally edit and run the test scripts right from your development environment or from Rational TestManager.

With QualityArchitect, you can:

- Generate test scripts that unit test individual methods or functions in a component-under-test.
- Generate test scripts that drive the business logic in a set of integrated components. Scripts can be generated directly from Rose interaction diagrams or from live components using the Session Recorder.
- Generate stubs that allow you to test components in isolation, apart from other components called by the component-under-test.
- Track code coverage through Rational PureCoverage and model-level coverage through Rational TestManager.

What You Need to Get Started

To develop tests with QualityArchitect, you need:

- A workstation running Microsoft NT 4.0, Windows 2000, Windows 95, Windows 98, or Windows ME. (EJB script playback requires Windows 2000 or Windows NT 4.0.)
- Rational Rose
- A project for storing your test assets (created with Rational Administrator)
- Rational TestManager (optional)

  TestManager can be purchased as part of any Suite, part of Robot or TeamTest, or as a standalone product.

Supported Environments

QualityArchitect supports the following environments:

For Testing Enterprise JavaBeans

- Any version from 1.1.7 to 1.2.2 of the Sun Java Developer Kit (JDK)
- Version 3.02 or later of IBM Visual Age for Java or Version 3.1 or later of Visual Cafe, Enterprise Edition
- Version 3.02 or later of IBM WebSphere, Advanced Edition or Version 4.0 or later of BEA WebLogic

For Testing COM, DCOM, and COM+ Components

- Microsoft Visual Basic 6.0

Installing Rational QualityArchitect

Rational QualityArchitect can be installed as part of Rational Suite DevelopmentStudio, Rational Suite Enterprise, or Rational Rose Enterprise. For information regarding the Rational Suite installations, see the *Installing Rational Suite* manual. For information about the Rose installation, see the *Installing Rational Rose* manual.

The installation adds a QualityArchitect subdirectory to your Rational Test directory.

Quick Start

To get started with Rational QualityArchitect, perform the following steps.

Working in Rose

1. If you have an existing component, reverse engineer it into your Rose model. (Skip this step if you are already modeling your system and components in Rose.)

   For EJBs, a good way to do this is with the Rose/Java Add-in. Simply make a jar file and drop the jar file on a class diagram. Be sure to include only the source (`.java`) files for the Remote interface, the Home interface, and the Bean itself. Do not import any `.class` files compiled from the source files because these will not be properly reverse-engineered with parameter names.

For more information, see *Reverse Engineering Java Source* in your RoseJ online Help.

2 Choose a template for the test generation process. This template contains replacement variables that get populated when you generate the test script. (A template will be provided for you by default.) For more information, see *Templates* on page 7 and *Template Replacement Variables* on page 99.

In Rose, right-click a model element to test and click **Rational Test > Select Unit Test Template**.

3 To create a unit test, right-click the item to test and click **Rational Test > Generate Unit Test.**

For information about testing your business logic, see *Using EJB Scenario Tests to Test Transactions* on page 50 or *Using COM Scenario Tests to Test Transactions* on page 90. For information about generating EJB test scripts with the Session Recorder, see *Using the EJB Session Recorder* on page 60.

Working in Your IDE

After you generate your test assets, you must add them to a project in your IDE, where you can run the tests.

The basic steps for working in your IDE are as follows:

Working in VisualAge for Java (VAJ)

If you are using IBM Visual Age for Java (VAJ), this means importing the test assets into the VAJ repository. For details, see *Importing Test Assets into VAJ* on page 46.

Working in Visual Cafe

In Visual Cafe:

1 Open a project.

2 Add the test scripts to the project. See *Adding an existing file to a project* in the Visual Cafe Help.

3 Update the CLASSPATH in Visual Cafe, adding references to rttseajava.jar, rttssjava.jar, and rational_ct.jar. (See *Requirements for EJB Testing* on page 29.)

4 Start the WebLogic server.

5 Click **Project > Execute** to run the test.

Working In Visual Basic

Every generated test of a COM component results in the creation of a Visual Basic project and several other files. For a list and description of these generated files, see *Programming in Visual Basic* on page 82.

To run your test in Visual Basic:

1 Open the Visual Basic project file.

2 Edit the .cls file as needed.

3 Click **Run > Start with Full Compile**.

Basic Concepts 2

This chapter discusses several basic concepts that will help you take advantage of the features provided with Rational QualityArchitect.

Topics include:

- Test script basics
- Templates
- Scenario tests
- Stubs
- Test script services

For information about concepts that apply to specific component models, see the chapters that describe each particular model.

Test Script Basics

QualityArchitect generates *test scripts* that drive and validate the component-under-test. Test scripts are generated in various languages, depending on the type of component you are testing.

If you are testing . . .	The test script is written in . . .
Enterprise JavaBeans	Java
COM components	Visual Basic

Test Types

There are two types of test scripts that QualityArchitect can generate from Rose:

- Unit tests
- Scenario tests

A *unit test* tests the behavior of an individual method or operation.

A *scenario test* tests the behavior of components as specified in an interaction diagram. These tests are intended to replicate the sequence of events in a transaction, and as such, test the implementation of the transaction. You can use interaction diagrams to construct simple scenario tests involving a single component or complex tests involving multiple components.

In addition, there is another kind of test script that you can generate with the EJB Session Recorder. For details, see *Using the EJB Session Recorder* on page 60.

Storing Your Tests Scripts

Projects for storing test assets are created in the Rational Administrator. Each project can contain several datastores—for example, a datastore for test assets, a datastore for requirements, and a datastore for change requests.

Certain test assets for QualityArchitect, such as datapools, lookup tables, and log files are stored in the test datastore. Test scripts, however, can be stored independently of the test datastore, in a location of your choice, where they can be placed under source control. When you generate your first test script, you will be prompted to log in to a project and to select a directory for storing your test scripts. QualityArchitect maintains an association between this directory and the project's test datastore.

Note: If you want to share your test scripts with a team, be sure to use a UNC path (*\\server-name\directory-path)* to create the project and a UNC path to specify your script source directory. Failure to do both of these will result in a project and script source that cannot be used in a group environment.

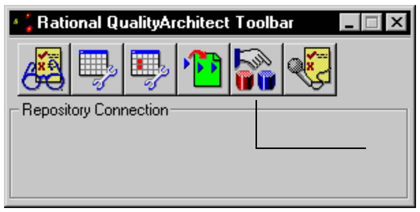
To start the Administrator:

- Click **Start > Programs** <*Rational . . .*> **Rational QualityArchitect Console**.

  where <*Rational . . .*> is the name of the Rational product you have installed—for example, Rational Suite DevelopmentStudio.

  This displays the Rational QualityArchitect toolbar.

- Click the **Administrator** icon on the toolbar.



Click to open the Administrator.

Templates

QualityArchitect uses templates to provide structure and common code to generated scripts and stubs. *Templates* are simply ASCII text files with replacement variables. The code generators supplied with QualityArchitect replace the variables in the templates with real code derived from Rose model elements.

All of the Rational templates can be customized. To create your own template, simply copy one of the supplied templates and edit it as needed. For example, to provide more logging information in your scripts, copy one of the supplied templates, add logging code, and generate tests with the new template.

Templates also provide a means for supporting additional environments, such as application servers. Generally, to add support for a new environment, you adjust a standard template, primarily in the initialization code, and then generate your test scripts using the new templates.

Rational has included several templates for your use. These templates can be logically grouped into the following general categories:

- Templates for unit test generation
- Templates for scenario test generation
- Templates for stub generation

Within each general category there are several templates for the various component models. You can browse through the Rational Test\QualityArchitect\Template directory to view the list of templates that are installed.

The following table lists the templates that are used for unit test generation:

Template	Description
weblogic_home.template	Template for testing the methods in the home interface of EJBs on a WebLogic server. Use this template: ▪ To ensure that the remote interface can be created successfully ▪ As a check prior to writing or running method-level tests
weblogic_remote.template	Template for testing the methods in the remote interface of EJBs on a WebLogic server.
websphere_home.template	Template for testing the methods in the home interface of EJBs in the WebSphere environment.
websphere_remote.template	Template for testing the methods in the remote interface of EJBs in the WebSphere environment.

Template	Description
TestNameScript.cls	Template for the Visual Basic .cls file that is generated to test a COM component. The .CLS file is the template for the actual test program.
TestName.vbp	Template for the Visual Basic project file that is generated to test a COM component.
TestNameMain.bas	Template for the main program that calls the test program in the .CLS file. Visual Basic requires a *main* program to begin execution.
TestName.res	Template for the resource file that is created to support datapools.

For more information about templates, see *Templates for Scenario Test Generation* on page 11, *Templates for Stub Generation* on page 19, and *Template Replacement Variables* on page 99.

Scenario Tests

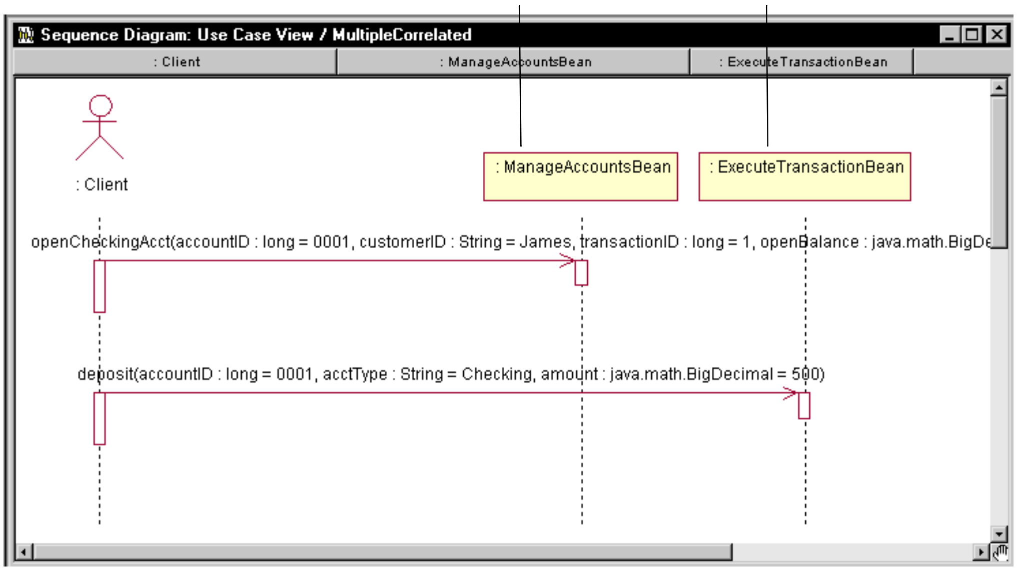
Scenario tests use Rose interaction diagrams—that is, sequence and collaboration diagrams—to test transactions. QualityArchitect interprets the messages in the interaction diagram and generates test scripts for one or more receiver objects in the diagram. (The *receiver object* is the object that receives the message.)

Each message in a diagram corresponds to an operation of a class, either by direct linkage through the diagram or by name. Each argument in a message maps to a corresponding parameter object attached to the operation object of the class.

As it generates the test script, QualityArchitect allows you to insert an optional verification point for each message in the diagram. (A *verification point* is a functional testing construct used by a test script to verify specific behavior. See *Verification Points* on page 23 for more information.)

Receiver object for `openAcct` message

Receiver object for `deposit` message


Sequence Diagram: Use Case View / MultipleCorrelated
: Client
: ManageAccountsBean
: ExecuteTransactionBean
: Client
: ManageAccountsBean
: ExecuteTransactionBean
openCheckingAcct(accountID : long = 0001, customerID : String = James, transactionID : long = 1, openBalance : java.math.BigDe
deposit(accountID : long = 0001, acctType : String = Checking, amount : java.math.BigDecimal = 500)

Scenario test scripts include support for datapools, logging, and verification points. (A *datapool* is a set of records that you can use to drive a test script. See *Datapools* on page 20 for details.) The scenario test templates provide automatic support for datapools and logging, while verification points may be added during script generation.

The basic steps for creating a scenario test are as follows:

1 Create a sequence or collaboration diagram in Rose.

2 Select the objects involved in the transaction and add them to the diagram.

3 Add messages for the operations that implement the transaction.

4 Add parameter names and data to the messages (optional).

   In this step, you can modify message syntax to permit automated data correlation. For more information, see *Message Signatures and Data Correlation* on page 11.

5 Select a scenario test template.

6 Generate the scenario test and insert verification points.

   For more information, see *Using the Java Query Builder to Add Verification Points* on page 53 and *Using the OLE DB Query Builder to Add Verification Points* on page 92.

7 Edit datapool data.

For more information, see *Datapools in Scenario Tests* on page 21. For information about creating datapools for EJB unit tests, see *Creating a Datapool for the Unit Test* on page 43. For information about creating datapools for COM unit tests, see *Creating a Datapool* on page 87.

Support for Performance Testing

In addition to using scenario test scripts for functional testing, you can use them for performance testing, that is, to measure how long a transaction takes to complete. QualityArchitect includes scenario testing templates that have been designed specifically for this purpose. Simply uncomment the line in the template for the `TSSMeasure` class, which is used to measure performance, as shown in the following EJB example.

```
public void testMain(String[] args) {
   boolean fRetval = false;
   TSSMeasure tss = new TSSMeasure(); // used for measuring performance
   TSSDataPool dp = new TSSDataPool();
   int iDPCount = 0;
```

For more information, see the documentation for the `TSSMeasure` class in the *Rational Test Script Services for Java* manual and the *Rational Test Script Services for Visual Basic* manual.

Support for Verification Points

Typically, components tested with QualityArchitect are transactional, and as such they make updates to a database. Therefore, verification must include a way to verify these database transactions. Because scenario tests specifically test these transactions, QualityArchitect provides database verification points to verify any changes to the underlying database. When you generate a scenario test, QualityArchitect prompts you to insert a database verification point for each message in your interaction diagram.

For overview information about verification points, see *Verification Points* on page 23.

For detailed information about database verification points, see the documentation for the `DatabaseVP` class in the *Rational Test Script Services for Java* manual and the *Rational Test Script Services for Visual Basic* manual.

Templates for Scenario Test Generation

QualityArchitect includes several templates that are used to generate scenario tests for each supported component model or application server. The templates shown in the first row in the table below are the ones you can select for test script generation. The other templates are called by the template you select. The following templates are included with QualityArchitect:

Template	**Description**
websphere_scenario.template weblogic_scenario.template com_scenario_script.template	Top-level templates for testing the sequence of methods specified in an interaction diagram. Each top-level template contains substitution variables for the method calls listed in the interaction diagram.
websphere_scenario_constructor.template weblogic_scenario_constructor.template com_scenario_constructor.template	Templates for building the constructor. For EJBs, the constructor builds the remote interface. For COM, it builds the COM object.
scenario_java_method1.template scenario_java_method2.template com_scenario_operation.template	Templates for generating the method calls. These templates include functions for calling individual methods within the sequence and for functions such as `tssCommandStart` and `tssCommandEnd`, which are used for performance testing.
com_scenario_project	Template for the Visual Basic project file that is generated to test a COM scenario
com_scenario_basmain.template	Template for the main Visual Basic program that calls the test program in the .CLS file. Visual Basic requires a *main* program to begin execution.

Message Signatures and Data Correlation

Message signatures include all of the message text that appears in parenthesis in a Rose interaction diagram.

In the following message, for example, the message signature is shown in bold:

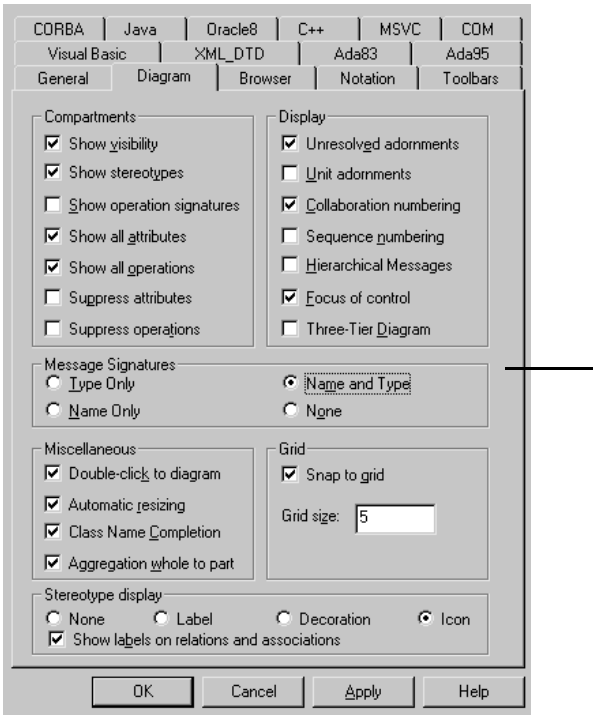
```
openCheckingAcct(accountID : long, customerID : String, transactionID
: long, openBalance : java.math.BigDecimal)
```

Signature Options

Rose supports several options for displaying message signatures:

- Type Only
- Name Only
- Name and Type
- None

You set these options in Rose by clicking **Tools -> Options -> Diagram** and clicking one of the check boxes inside the Message Signatures box.



Compartments
- [✓] Show visibility
- [✓] Show stereotypes
- [ ] Show operation signatures
- [✓] Show all attributes
- [✓] Show all operations
- [ ] Suppress attributes
- [ ] Suppress operations

Display
- [✓] Unresolved adornments
- [ ] Unit adornments
- [✓] Collaboration numbering
- [ ] Sequence numbering
- [ ] Hierarchical Messages
- [✓] Focus of control
- [ ] Three-Tier Diagram

Message Signatures: Type Only / Name Only / [✓ Name and Type] / None

Miscellaneous
- [✓] Double-click to diagram
- [✓] Automatic resizing
- [✓] Class Name Completion
- [✓] Aggregation whole to part

Grid
- [✓] Snap to grid
- Grid size: 5

Stereotype display: None / Label / Decoration / [✓ Icon]
- [✓] Show labels on relations and associations

You can use message signatures for several purposes. For example, you can:

- Change parameter names to force the correlation results that you want
- Add assignments to give initial values to parameters
- Add assignments to give names to function results correlated with parameters

Note: However, if you change message signature options from one style to another—say, from Name and Type to Type Only—every modification made to a message name is erased. Therefore, decide early on how you want message signatures displayed and do not change the options after you have modified the messages.

Message Syntax

When you generate a scenario test, QualityArchitect parses the diagram to determine the name, type and initial data for each parameter (argument) in a message signature.

- **Parameter name**. For each parameter in the message signature, QualityArchitect uses the name from the message signature in the diagram. If no name is included in the message, QualityArchitect uses the name property of the associated parameter.
- **Parameter type**. For each parameter in the message signature, QualityArchitect uses the type from the associated parameter object, regardless of what is in the diagram.
- **Parameter 's initial data**. For each parameter in the message signature, QualityArchitect uses the value to the right of the equal sign. If no initial data is included in the signature, QualityArchitect uses the Initial Data property of the associated parameter. If no Initial Data property is set and no initial data is specified in the diagram, then NULL or some other suitable value for the data type is used. Thus, you can select the **None** option in the Message Signatures box and still get a valid test script.

Note: When only the name or type of a parameter is present in the message, QualityArchitect compares it to the actual type in the corresponding parameter object. If they are the same, QualityArchitect uses the name from the parameter object as the script variable name for the parameter. If they are different, QualityArchitect uses the name as used in the message and the type is taken from the parameter object.

Message syntax for the Name and Type option is as follows:

Result = operation([parameter$_1$: type$_1$ = value$_1$, parameter$_n$: type$_n$ = value$_n$, etc])

Item	Description
Result	The value (if any) returned by the operation. It is used by QualityArchitect for correlation with parameters of the same name later in the transaction. Result is optional.
Operation	The name of the operation as defined in a UML class.
Parameter Type Value	Parameter, type, and value define a parameter of the operation and it's initial value. Parameter and type are both optional, because QualityArchitect examines the parameter object. The syntax that separates them with a colon is the UML syntax for separating parameter name and type. In QualityArchitect, you can add the assignment syntax (= value) to allow the initial value of a parameter to be specified in the sequence diagram.

Editing Message Signatures

You edit message signatures to tell QualityArchitect three things, all of which are optional:

- Parameter names that are different from their parameter specification
- Initial data
- The name of the return value

QualityArchitect generates a variable in the test script to hold the return value (result) if you do not supply one. The following naming convention is used:

`retval_`*<classname>*

where *<classname>* is the class name of the receiver object.

Typically, you might name a return value if you want to use the value in a subsequent message as a parameter.

How Message Signatures Correlate to Datapool Fields

When you generate a scenario test, QualityArchitect also generates a corresponding datapool (see *Datapools in Scenario Tests* on page 21). QualityArchitect first examines the arguments in the message signatures to determine how many datapool fields to create. If no argument names are included in the signature, QualityArchitect supplies the names by searching the parameter (object) of the corresponding operation of the class.

If QualityArchitect finds an argument named `accountID`, for example, in multiple messages, it creates a single datapool field for `accountID`. If you want to have multiple datapool fields for `accountID`, you need to assign `accountID` different names in the diagram, regardless of the Rose Message Signature Option you have picked.

Message Signature Examples

This section provides several samples of message signatures.

Example 1—the Name-Only Option

In this example, there is a `getBalance` operation in the `ExecuteTransaction` class. This operation takes one argument—`accountID`. If you want to generate a test script with two calls to this operation, with each call operating on different `accountIDs`, you need to code your message signatures as follows:

```
getBalance(accountID1)
getBalance(accountID2)
```

In this example, two datapool fields will be created—one for `accountID1` and one for `accountID2`.

If you want these operations to go against the same account, driven from a datapool, you need to code your message signatures as follows:

```
getBalance(accountID)
getBalance(accountID)
```

The fact that both operations use the same argument name ensures that they are assigned to the same datapool field.

If you want to initialize these operations with data and assign them different names, code the message signatures as follows:

```
getBalance(accountID1 = 1)
getBalance(accountID2 = 5)
```

Example 2—the Type-Only Option

If you use the Type-Only option, code your message signatures as follows to get the same datapool field for both calls:

```
getBalance( : Long)
getBalance( : Long)
```

In this case, the name of the datapool field will be taken from the parameter name of the parameter object.

If you want different datapool fields for each call, you have to add the name to the signature, as in the following example, even if you have set Rose Options to Type-Only.

```
getBalance(accountID1 : long = 1)
```

```
getBalance(accountID2 : long = 5
```

Example 3—Name and Type

This example shows the message signature when you display name and type without including parameter values or assignment statements.

```
getBalance(acctountID : long, acctType : java.lang.String, amount :
java.mathBigDecimal)
```

Example 4—Name and Type with Parameter Values

This example shows the message signature after you add the initial data assigned to each parameter.

```
getBalance(acctountID : long = 1, acctType : java.lang.String =
"checking", amount : java.mathBigDecimal = 50)
```

Example 5—Name and Type with Assignment Statement

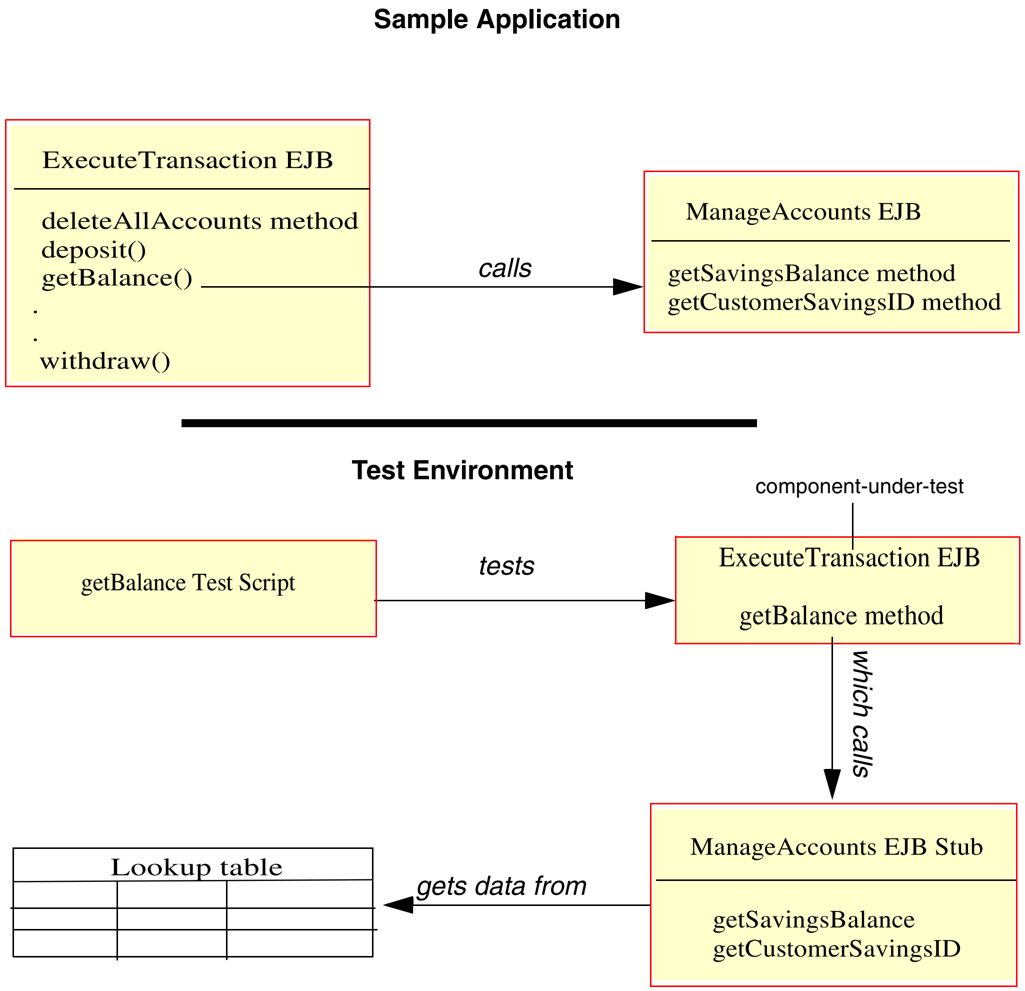
Finally, if the message returns a value and you want to establish a variable in the test script to hold this value, possibly for use as a parameter of data in a subsequent message, you need to convert the message name into an assignment statement. In this example, the variable named `result` is declared and used in the test script to hold the value returned by the `getBalance()` function.

```
result = getBalance(acctID : long = 1, acctType : java.lang.String =
"checking", amount : java.mathBigDecimal = 50)
```

Stubs

Stubs are components that can be used for testing purposes in place of actual components. A stub can either be a pure "dummy" component that just returns some predefined value, or it can simulate more complex behavior. With QualityArchitect, the simulated behavior for stubbed operations is specified in a lookup table. Through the use of stubs, you can control the results returned from components that interact with the component-under-test and create a simulated, controlled test environment.

Consider the sample EJB application that is described in the chapter on *Testing Enterprise JavaBeans*. In this chapter, you create a test script to test the `getBalance` method that is included with the `ExecuteTransaction` interface. Because the `getBalance` method calls several methods in the `ManageAccount` EJB, such as `getSavingsBalance` and `getSavingsCustomerID`, you would need to control access to the `ManageAccount` EJB to thoroughly test the `getBalance` method. As an alternative, you can create a stub for the `ManageAccount` EJB and control the results returned when `getBalance` calls the methods in the `ManageAccount` EJB.



In a stub, any method that is called by the component-under-test requires a lookup table consisting of rows and columns of expected results and exceptions for the method, as in the following example:

AccountID	expectedReturn	expectedException
012 34 5678	012 34 5678	
123 45 6789	123 45 67891	
234 56 7890		java.lang.Exception

Generate the table and columns with **Stubs > Create Look-up**

Use the Datapool Manager to populate the table.

The lookup table contains one or more columns for each parameter of the operation being stubbed. QualityArchitect uses the values in the columns to determine how the operation should behave. If the operation is supposed to return a value, the value is shown in the `expectedReturn` column. If the operation is supposed to throw an exception, the type of exception is shown in the `expectedException` column.

The stub looks up the row containing the inputs matching the parameter values passed in by the component-under-test, that is, the caller of the stub, and either returns the value in the `expectedReturn` column or throws the exception in the `expectedException` column.

To generate stubs:

1 In the Rose browser, right-click the implementation class you are testing and click **Generate Stubs**.

2 Select a directory for storing the stubs.

For more information about stubs for EJBs, see *Generating Stubs for the Unit Test* on page 45. For more information about stubs for COM components, see *Generating Stubs for the Unit Test* on page 88.

To generate a lookup table:

1 Select a method called by the method you are testing.

2 Click **Tools > Rational Test > Stubs > Create Look-up table**.

The lookup table is created with the name *ClassName_OperationName*_L, for example `ExecuteTransaction_getBalance_L`.

3 Use the datapool manager to populate the lookup table with data.

For information about populating datapools for EJBs, see *Creating a Datapool for the Unit Test* on page 43. For information about populating datapools for COM components, see *Creating a Datapool* on page 87.

For more information about lookup tables for testing EJBs, see *Creating Lookup Tables* on page 46. For more information about lookup tables for testing COM components, see *Creating Lookup Tables* on page 89.

Note: Stubs must be deployed on the same computer as the test script. Otherwise, playback will fail.

Templates for Stub Generation

The following table lists the templates that are used for EJB stub generation:

Template	**Description**
Session_Home.template	Template used to generate the stub for an EJB home interface.
Session_Remote.template	Template used to generate the stub for an EJB remote interface.
Session_Bean.template	Template used to generate the stub for an EJB implementation class. The following four templates are used to build the method body in the implementation class. The template that is used depends on the particular method.
MethodBodyWithoutLookUp.template	Template used when lookup code cannot be generated either because: ▪ The method has no parameters ▪ The method has no return value or exceptions ▪ The method contains at least one complex parameter and lookup code cannot be generated automatically.
MethodBodyWithoutExceptions.template	Template used when the method throws no exceptions.
MethodBodyWithoutReturnValue.template	Template used when method has no return value (e.g. returns void).
MethodBody.template	Template used for all other methods.

The following table lists the templates that are used for COM/VB stub generation:

Template	Description
VBCOMClass.template	Template used in all cases to generate the code that defines the Visual Basic class. The following templates are used to create the method bodies for the stub. Different templates are used depending on the type of method being stubbed.
FunctionBody.template	Template used for functions. (Functions are methods that have return values.)
FunctionBodyWithoutLookUp.template	Template used for functions without parameters. (No look up code is generated when a method has no parameters.)
PropertyGetBody.template	Template used for "Property Get" methods.
PropertyGetBodyWithoutLookUp.template	Template used for "Property Get" methods without parameters. (No look up code is generated when a method has no parameters.)
PropertyLetBody.template	Template used for "Property Let" methods
SubBody.template	Template used for subroutines. (Subroutines are methods that have no return value)
SubBodyWithoutLookUp.template	Template used for subroutines without parameters (No look up code is generated when a method has no parameters.)

Test Script Services

Test Script Services provide datapool, logging, verification, synchronization, measurement, and monitoring capability to various Rational applications, including QualityArchitect.

Datapools

A *datapool* is a set of records that you can use to drive a test script. Typically, each record in the datapool represents a test case and includes either the test inputs, the expected results, or both. With a datapool, a single script can iterate through multiple test cases. If you want to add a new test case, such as the result of invalid input, you only need to add another record to the datapool.

For example, imagine you want to test an `add()` operation that takes two integers as parameters. If you want to test what happens when you pass it two negative integers, you can simply add another record to the datapool. Include negative integer values in each of the two parameter columns, and populate the expected result or expected exception columns accordingly.

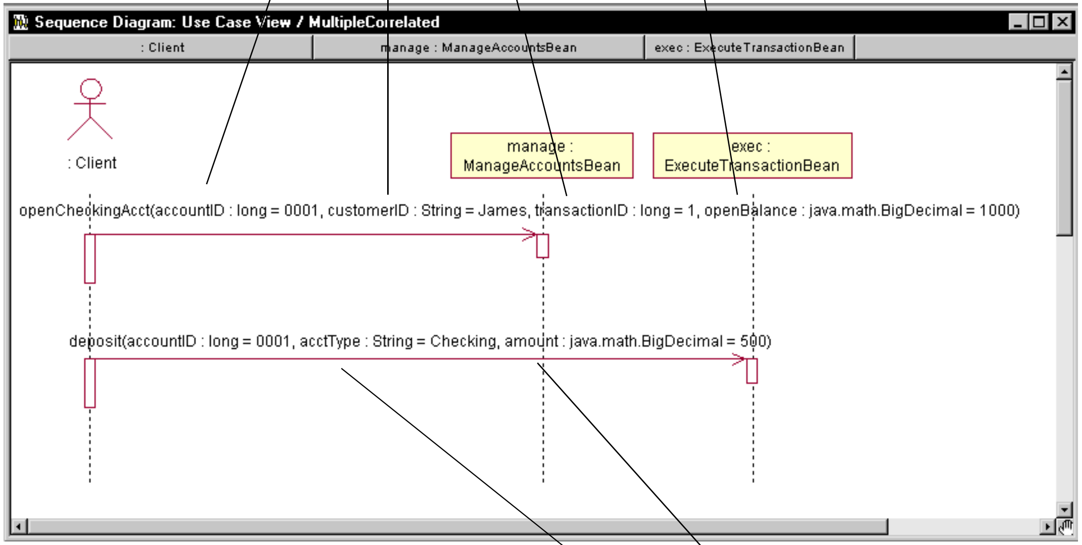
Datapools greatly reduce the number of test scripts that are required and minimize script maintenance.

Datapools in Scenario Tests

When you generate a scenario test, QualityArchitect creates a datapool automatically. It examines each message in an interaction diagram and populates one datapool row with data based on the parameter values in the messages. If it finds no parameter values in the messages, it attempts to populate the row with initial values found in the parameter specification.

QualityArchitect creates a datapool column for each unique parameter in each message in the diagram. For example, if the first message included in the script has four unique parameters, and the second message has two unique parameters, the datapool will have at least six columns. In addition, each verification point contributes several columns of data to the datapool. The initial data for these verification point columns is extracted from the values entered into the Query Builder wizard.

openCheckingAcct method - columns generated for: accountID, customerID, transaction ID, and openBalance


Sequence Diagram: Use Case View / MultipleCorrelated
: Client
manage : ManageAccountsBean
exec : ExecuteTransactionBean
: Client
manage : ManageAccountsBean
exec : ExecuteTransactionBean

openCheckingAcct(accountID : long = 0001, customerID : String = James, transactionID : long = 1, openBalance : java.math.BigDecimal = 1000)

deposit(accountID : long = 0001, acctType : String = Checking, amount : java.math.BigDecimal = 500)

deposit method - columns generated for acctType and amount

By default, QualityArchitect assigns the datapool a name of *ModelName_DiagramName__D.*

Datapools in Unit Tests

Datapools are not created automatically when you generate a unit test script. However, you can create a datapool very easily.

- Simply right-click an operation in the Rose browser and click **Rational Test > Create Datapool**.

QualityArchitect creates the new datapool and presents you with a dialog in which you can add rows of data. QualityArchitect uses the operation's parameters as datapool columns and names the datapool *ClassName_OperationName__D*.

Note: Because the datapool name and its column names are embedded in the script, you will need to modify your script if you change the datapool name.

For an EJB example, see *Creating a Datapool for the Unit Test* on page 43. For a COM example, see *Creating a Datapool* on page 87.

For detailed information on the use of datapools with other Rational Test products, see the Help for Rational TestManager and Rational Robot.

Data Types

Data types are used to define datapool columns. You assign data types to datapool columns when you define the columns in the Datapool Specification dialog box.

For Java, QualityArchitect supports all native data types plus `String` and `BigDecimal`.

For Visual Basic, values are retrieved as variants containing strings.

For a complete list of available data types, see the TestManager online Help.

Note: Complex data types are not currently supported in datapools. However, you can construct complex data types at runtime based on the primitive data types that the datapool supplies.

Verification Points

A verification point (VP) is a functional testing construct used by a test script to verify specific behavior in the application or component-under-test. In QualityArchitect, a verification point compares an *expected* data object with an *actual* data object. The result of this comparison is logged, allowing for analysis of overall functional correctness and test case coverage.

How Data Is Verified

A verification point operates on two different types of data:

- Data that is known to be correct.

  For example, this data might be captured when the component is known to be functioning correctly, or from a source that is known to contain the correct data. Data that is known to be correct is called the *expected* data.

- Data whose validity is unknown and must be verified.

  This data is captured at test runtime and is called the *actual* data.

A verification point compares expected data and actual data. If the data matches (or optionally, satisfies some other condition, such as falling within an accepted range), the verification point passes. Otherwise, the verification point fails. Verification point results are automatically logged and viewed in the Rational TestLog viewer.

Static, Dynamic, and Manual Verification Points

In QualityArchitect there are three types of verification points: static, dynamic, and manual.

Static Verification Points

With a static verification point, the expected data object is captured the first time the verification point is executed and is stored in the datastore as the verification point's baseline. The expected data object does not change during subsequent executions of the test script. When the verification point is executed again:

- An actual data object is captured from the system-under-test.
- The baseline data object is retrieved from the datastore.
- The two objects are compared, and the result is logged.

Static verification points are regression-style tests in that the successful behavior of the system is implicitly defined by the system's behavior the first time the verification point executes. In other words, static verification points assume that the system-under-test is functionally correct the first time you run the verification point.

QualityArchitect contains a user-acknowledgement flag that lets you interactively accept or reject data as a baseline for a static verification point. With the flag enabled, QualityArchitect will prompt you with the baseline data that you can accept or reject. For details, see *Verification Point classes* in *Rational Test Script Services for Java* and *Rational Test Script Services for Visual Basic*.

Dynamic Verification Points

With a dynamic verification point, the expected data object is passed to the verification point at execution time. This expected data object is not managed by the verification point infrastructure and may be hard coded into the script, driven by values in a datapool, or built using any other method chosen by the test script author. When a dynamic verification point is executed, an expected data object is passed to the verification point by the test script. The verification point captures an actual data object from the system-under-test, compares the expected and actual data objects, and logs the result. Dynamic verification points differ from static verification points in that the successful behavior of the system under test is explicitly defined by the test script author, not implicitly defined by a previous behavior of the system-under-test.

Manual Verification Points

With manual verification points, you as the scripter are responsible for providing both the expected and the actual data objects. The verification point framework simply compares the data objects you provide and logs the results.

Database Verification Point

In this release, Rational has implemented a single verification point: the database verification point. This verification point is used to validate the changes made to a data source by the component-under-test. If you are testing a component that makes modifications to a data source, you can invoke a method on that component and then use a database verification point to verify that the expected changes to the data source actually occurred.

With a static database verification point, the first time you run a test, the data is captured and stored in the datastore, thus establishing a baseline. Subsequent runs will show a pass in the Rational TestLog viewer if the returned values are the same as the values in the baseline. With a dynamic database verification point, the test script itself constructs the expected value.

The Query Builder

QualityArchitect provides a Query Builder wizard that lets you build and execute queries for use with a database verification point. Wizards are available for both EJB and COM. The wizards let you specify a data source and build a query.

The Query Builder appears automatically:

- When you insert a database verification point while generating a scenario test
- When you insert a database verification point from the EJB Session Recorder (EJB only)
- When you run a test containing an incompletely-specified database verification point

Extensibility

QualityArchitect provides you with the ability to implement your own verification points by extending the verification point framework classes. For details, see *Implementing a New Verification Point* in *Rational Test Script Services for Java* and *Rational Test Script Services for Visual Basic*.

Testing Enterprise JavaBeans 3

This chapter contains the information you need to use Rational QualityArchitect to test Enterprise JavaBeans (EJBs).

Topics include:

- Overview
- Requirements for EJB testing
- The Rational Bank Account Sample Application
- Generating test assets
- Importing test assets into IBM Visual Age for Java
- Executing test scripts
- Using scenario tests to test transactions
- Using the Query Builder to add verification points
- Using the EJB Session Recorder

Overview

This section provides a brief overview of EJB development and test.

For each EJB that you develop, you must define two interfaces and either one or two classes: the home interface, the remote interface, the implementation class, and the primary key class.

- The *remote interface* defines all of the bean's business methods.
- The *home interface* defines life-cycle methods for the bean, that is, methods for creating, removing, and finding beans.
- The *implementation* or *bean class* implements the business methods defined by the remote interface.
- The *primary key class* provides a pointer into a database. Only *entity beans* require a primary key.

Because client applications interact directly with the home and remote interfaces and not with the implementation class, and because test scripts emulate client applications, EJB testing only needs to test the methods defined in the remote and home interfaces.

EJB TestScripts

All test scripts that are generated or constructed manually extend `com.rational.test.tss.TestScript`, an abstract class that contains the code necessary to connect to a project, initialize log information, and look up the name of the script.

All EJB test scripts that extend the `TestScript` class must implement a `main` method and a `testMain` method.

- The `main` method is the entry point for the class.
- The `testMain` method is the entry point for the testing code. `testMain` includes all of your test logic. All calls to other test scripts must reside within `testMain`.

In addition, all EJB test scripts must call `tms.startTestServices` and `tms.endTestServices`.

- `tms.startTestServices` initializes logging and other test services and should be the first method called in `testMain` (within a try block).
- `tms.end TestServices` turns off logging, writes the log file, and performs various cleanup functions and should be the last method called in `testMain` (in your `finally` block).

Imported Packages

EJB test scripts must also import the following packages:

- `com.rational.test.ct.*`
- `com.rational.test.tss.*`
- `com.rational.test.vp.*`
- `com.rational.test.vp.ui.*`
- `java.util.*`
- `javax.naming.*`

In addition, any test script to be deployed in a WebSphere environment must import the following package:

- `javax.rmi.PortableRemoteObject`

For more information about the `TestScript` class, see the online documentation at Rational Test\Api\TssJava\Rational TSS for Java.htm. For test script examples, see the chapters pertaining to each component model.

Requirements for EJB Testing

This section describes the following configuration requirements for EJB testing:

- Test script playback requirements
- JRE requirements
- VAJ/WebSphere requirements
- Visual Cafe/WebLogic requirements

See *Session Recorder Requirements* on page 61 for additional requirements for the EJB Session Recorder.

Test Script Playback Requirements

The installation procedure includes several packages that are required for test script playback. These packages are installed in the form of JAR files. The JAR files must be added to your IDE's classpath to enable script playback from your IDE and added to your system classpath to enable script playback from the command line.

The required packages include:

- Rational Test Services (rational_ct.jar and rttsjava.jar)
- Rational Test Execution Adapter (rttseajava.jar)
- Swing v.1.1.1 (swingall.jar)
- JavaHelp v.1.1 (jh.jar)

  JavaHelp is required to display online Help for the EJB Query Builder and the EJB Session Recorder. If this JAR file is not included in the IDE's classpath, a `NoClassDefFoundError` will be generated when the Test Script is executed or when the Query Builder is launched.

JRE Requirements

The EJB Session Recorder and the Query Builder require that your JRE be in the range of v. 1.1.7 to 1.2.2.

Visual Age/WebSphere Requirements

In order to run the sample application, you need:

- Visual Age for Java 3.02 (VAJ) or newer
- The VAJ WebSphere Test Environment and VAJ EJB Development Environment

  See the VAJ online Help for details on how to load these features.
- DB2 version 6.1 with fix pack 2

  You can download FixPak 2 from http://www.ibm.com/DB2.

Visual Cafe/WebLogic Requirements

In order to run and deploy the sample application in a Visual Cafe/WebLogic environment, you need:

- Visual Café 3.1 or newer
- WebLogic 4.5.1 or newer

In addition, the Rational QualityArchitect installation installs a jar file —ratlbankacct.jar—and a CloudScape database, both of which are needed to run the sample application.

The Rational Bank Account Sample Application

The Rational Bank Account sample application is a Java-based client that you can use to try out the features in QualityArchitect. With the Rational Bank Account sample application, you can set up bank accounts and make deposits and withdrawals. The application consists of:

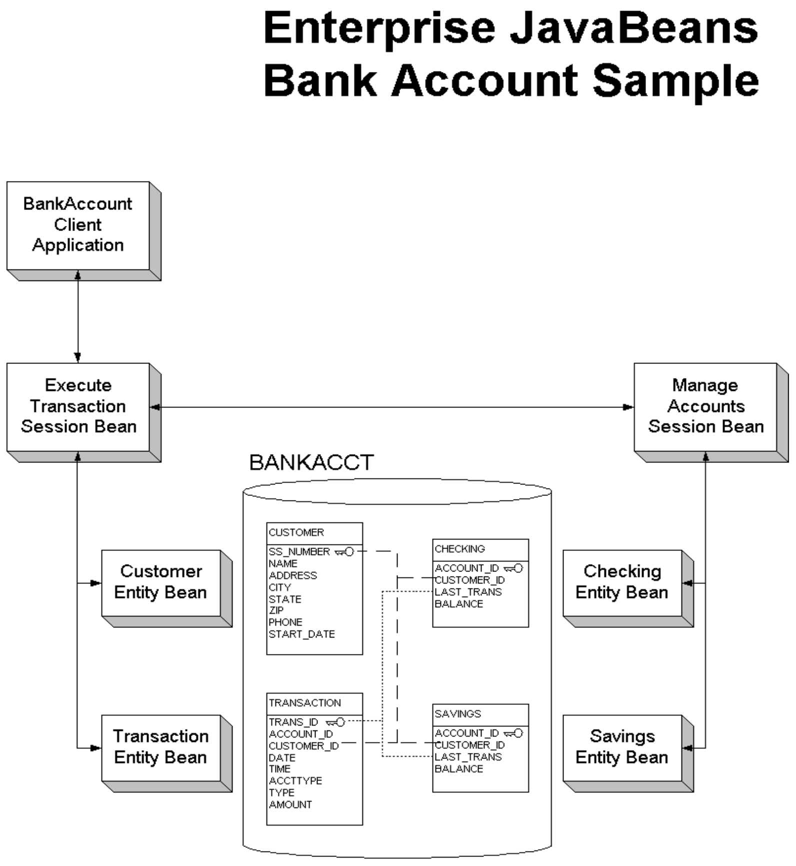
- A Java-based client application
- A set of six EJBs—four entity beans and two session beans

  Each entity bean corresponds to a different table in a database and uses *container managed persistence*. The session beans are stateless and are used to interact with the client and the entity beans to manage transactions with the database.
- A pair of Rose models—ratlbankacct.mdl and ratlbankacctj2ee.mdl—that you can use to generate test scripts and stubs against the sample EJBs that are provided.

The first model—ratlbankacct.mdl—is populated with objects derived from reverse-engineering the sample application's Java source code. The second model—ratlbankacctj2ee—uses the J2EE modeling support built into Rose-J to model the beans in the sample application. The ratlbankacctj2ee model implements a standard profile for stereotypes for modeling EJBs in UML.

The following sections are based on the first model—ratlbankacct.mdl. For more information about J2EE modeling support, see *How Rational Rose Supports the Java Platform Enterprise Edition (J2EE)* in the RoseJ Online Help.

The following figure shows the structure of the Rational Bank Account sample application.



Sample Procedures

The procedures that are used to demonstrate EJB testing with QualityArchitect are all based on the sample application. For example, one procedure shows you how to generate a unit test for the `getBalance` method in the `ExecuteTransaction` remote interface, while another procedure shows you how to create a stub for the methods that are called by `getBalance` method.

Setting Up the Sample Application for VAJ/WebSphere

This section shows you how to set up the sample application to run in a VAJ/WebSphere environment.

Importing the Sample into VAJ

Before you can run the sample application, you must import it into VAJ, as follows:

1 Start IBM Visual Enterprise for Java (VAJ).

2 Within the VAJ Workbench window, click the **Projects** tab.

3 Right-click anywhere in the window and click **Import….**

4 When the SmartGuide dialog appears, select **Repository** as the import source and click **Next**.

5 Select **Local Repository**, click the **Browse…** button, and navigate to the *<install directory>* Program Files\Rational\Rational Test\QualityArchitect\Samples\ejb\vaj directory.

6 For VAJ 3.0x, choose RatlBankAcct30.dat and click **Open**. For VAJ 3.5, choose RatlBankAcct35.dat and click **Open**.

7 Make sure **Projects** is selected in the 'What do you want to import?' section.

8 Click **Details**….

9 Select **Rational Bank Account Sample** in the Projects list.

- For VAJ 3.0x, make sure **1.2.1** is selected in the Versions window.
- For VAJ 3.5, make sure **1.2.2** is selected in the Versions window.

10 Make sure **Add most recent project edition to workspace** is checked.

11 Click **OK**.

12 Click **Finish** to import the sample into the repository.

If you cannot see the Rational Bank Account Sample project in the Projects window:

1 Right click in the window and select **Add > Project....**

2 Select **Add projects from the repository**.

3 Select **Rational Bank Account Sample** from the Available project names list.

   - For VAJ 3.0x, make sure **1.2.1** is selected in the Versions window.
   - For VAJ 3.5, make sure **1.2.2** is selected in the Versions window.

4 Click **Finish**.

   You should now see the Rational Bank Account Sample project in the Projects window.

Creating the Database

To run the sample, you must first create a database in DB2 and then configure VAJ to use the database. Because of limitations in VAJ, the database must reside on the same server as the sample application.

To create the database:

1 From the Start menu, click **Programs > Db2 for Windows NT > Command Line Processor** to launch the DB2 Command Line Processor.

2 At the `db2=>` prompt, type **create database** *<database name>*, where *<database name>* is the actual name of the database that will be used for the sample, for example, **create database bankacct**.

   You should see a return message in the window that states the database was created successfully.

3 Close the Command Line Processor window by typing **close** at the `db2=>` prompt.

Configuring VAJ to Use the New Sample Database

To configure VAJ to use the new sample database:

1 Launch VAJ.

2 Specify the DB2 JDBC driver to use.

   a From the Workbench, click **Window > Options**.

   b In the Options dialog box, select **Resources** and enter the following information in the Workspace class path text box:

   <DB2 Path>\java\db2java.zip

where *<DB2 Path>* is the full DB2 installation path and db2java.zip is the DB2 JDBC driver. The default DB2 installation directory is SQLLIB.

If you do not know where DB2 is installed, search on the file name db2java.zip to determine the full file path. Here is an example of the JDBC driver path:

```
D:\SQLLIB\java\db2java.zip
```

c Click **Apply** to save the selected DB2 JDBC driver information, and then click **OK**.

Deploying the Sample Application in the VAJ Test Environment

This section includes instructions that apply to VAJ 3.0x and VAJ 3.5.

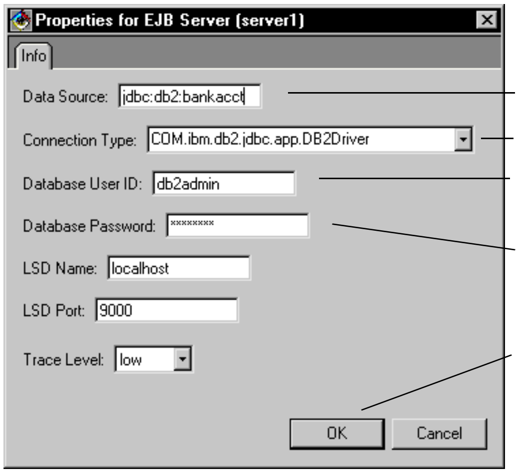
Instructions for Both VAJ 3.0x and VAJ 3.5

1 In VAJ, click the **EJB** tab to view the EJB window.

You should now see the RationalBankAcctSampleEJBs group in the window.

2 Right-click **RationalBankAcctSampleEJBs** and choose **Add To > Server Configuration**.

3 Right-click **EJB Server (server 1)** and choose **Properties**.



Data Source: jdbc:db2:bankacct
Connection Type: COM.ibm.db2.jdbc.app.DB2Driver
Database User ID: db2admin
Database Password: ********
LSD Name: localhost
LSD Port: 9000
Trace Level: low

Enter **jdbc:db2:***<database name>*.

Select COM.ibm.db2.jdbc.app.DB2Driver.

Enter the administration ID that was chosen when DB2 was installed, usually **db2admin**.

Enter the administration password that was chosen when DB2 was installed, usually **db2admin**.

Click **OK**.

4 Right-click **EJB Server (server 1)** again and choose **Create Database Table**.

This creates the database tables that are required for the sample.

At this point the deployment process varies, depending on your version of VAJ. See either *Instructions for VAJ 3.0x Only* on page 35 or *Instructions for VAJ 3.5 Only* on page 35.

Instructions for VAJ 3.0x Only

1 Right-click **Location Service Daemon** and choose **Start Server**.

The Location Server Daemon is used to facilitate the WebSphere Test Environment.

2 Right-click **Persistent Name Server** and choose **Start Server**.

The Persistent Name Server is the JNDI server that is required for the naming service.

The VAJ Console window should appear. You will know that the server has been successfully started when the following line appears in the Output box:

```
EJServer E Server open for business
```

Instructions for VAJ 3.5 Only

1 From the Workbench window, click **Workspace > Tools > WebSphere Test Environment**.

This opens the WebSphere Test Environment Control Center.

2 Click **Servlet Engine** and then click **Start Servlet Engine**.

The VAJ Console window should appear. You will know that the server has been successfully started when the following line appears in the Output box:

```
Servlet Engine is started
```

3 Click **Persistent Name Server** and choose **Start Name Server**.

The Persistent Name Server is the JNDI server that is required for the naming service.

You will know that the server has been successfully started when the following line appears in the Output box:

```
Persistent Name Server is Started
```

Instructions for Both VAJ 3.0x and VAJ 3.5

From this point on, the instructions are the same for VAJ 3.0x and VAJ 3.5.

1 Back in the EJB Server Configuration window, right-click **EJB Server (server 1)** and choose **Start Server**.

2 Click on the Console window to bring it to the front.

Note: It might take a moment for the Console window to be brought to the front.

3 In the All Programs box, click the last EJB Server entry.

You will know that the server has been successfully started when the following line appears in the Output box:

```
EJServer E Server open for business
```

4 Click the **Projects** tab in the VAJ Workbench window.

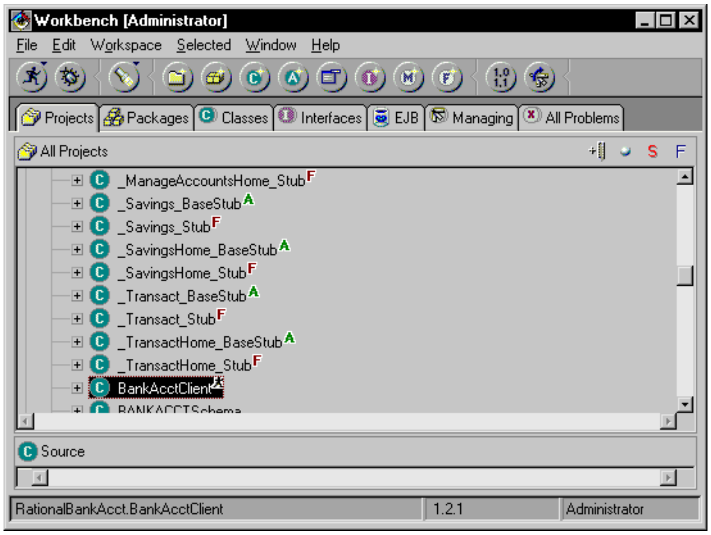
5 Find the Rational Bank Account Sample in the window and expand it by clicking on the **+** box.

If there is a **-** in the box, then it is already expanded.

6 Expand the RationalBankAcct package by clicking the **+** box.

If there is a - in the box, then it is already expanded.

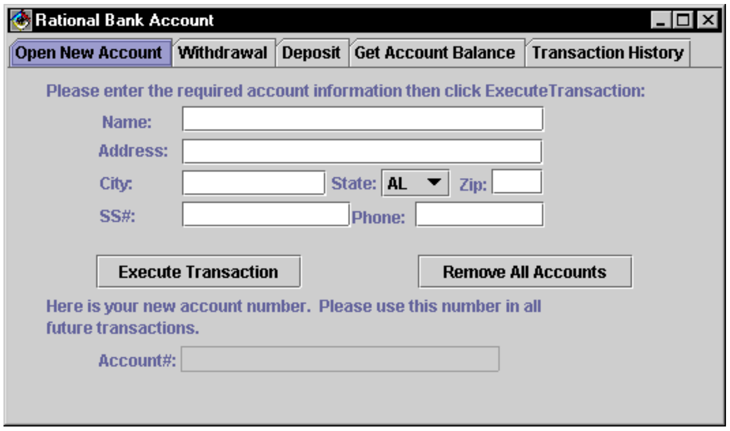
7 Scroll until you see the BankAcctClient class. It should have a little picture of a running man to its right.



8 Right-click on this class and click **Run > Check Classpath**.

9 Click **Compute Now** and then click **OK** to add the path of the generated test script to the ClassPath.

10 Right-click on this class and choose **Run > Run main....**



Please enter the required account information then click ExecuteTransaction:

Name:			
Address:			
City:		State:	AL
		Zip:	
SS#:		Phone:	

Here is your new account number. Please use this number in all future transactions.

Account#:

You should then see the Rational Bank Account window in the upper left of your screen. You will use this client application to add database entries that you can use for testing purposes. For details, see *Adding Account Information to the Rational Bank Account Sample* on page 39.

Importing Swing and the Rational Support Classes

Before importing generated test scripts into VAJ, you must import the Swing foundation class library (swingall.jar) and the Rational support classes (rational_ct.jar, rttseajava.jar, and rttsjava.jar). Swing is required for various UI components, such as the Query Builder and the Session Recorder. The Rational support classes provide support verification points, datapools, stub generation, and other services. These JAR files must be added to VAJ's classpath to enable script playback from VAJ.

To prevent warning messages in VAJ, import swingall.jar first, before importing the Rational support classes.

Deploying the Sample Application in WebLogic

This section describes how to deploy the sample application in WebLogic. It is assumed that you have already installed Visual Café 3.1 and WebLogic 4.5.1.

To deploy the sample application in WebLogic:

1 Create a subdirectory within the *<weblogic directory>/myserver* directory called RatlBankAcct.

2 Copy the RatlBankAcct.jar file from the Rational Test/QualityArchitect/Samples/ejb/bankacct/vc directory to the *<weblogic directory>/myserver/*RatlBankAcct directory that was created in the previous step.

3 Copy the bankacct directory from Rational Test/QualityArchitect/Samples/VC to *<weblogic directory>*/eval/cloudscape/data.

This directory contains the Cloudscape database for the sample. (See the Cloudscape readme file for details.)

4 Open the weblogic.properties file, found in *<weblogic directory>*, for editing. Uncomment (remove the # symbol from the beginning of the line) the following lines found in the WEBLOGIC DEMO CONNECTION POOL PROPERTIES section:

```
weblogic.jdbc.connectionPool.demoPool=\
   url=jdbc:cloudscape:demo;upgrade=true,\
   driver=COM.cloudscape.core.JDBCDriver,\
   initialCapacity=1,\
   maxCapacity=2,\
   capacityIncrement=1,\
   props=user=none;password=none;server=none
weblogic.allow.reserve.weblogic.jdbc.connectionPool.demoPool=everyo
ne
```

5 Change the line `url=jdbc:cloudscape:demo;upgrade=true,\` to `url=jdbc:cloudscape:bankacct,\`

6 Add the following lines right after the WEBLOGIC EJB DEMO PROPERTIES section:

```
weblogic.ejb.deploy=\
   <weblogic directory>/myserver/RatlBankAcct/RatlBankAcct.jar
```

7 Save the weblogic.properties file.

8 Launch the WebLogic Server by going to the **Start** menu and selecting **Programs/WebLogic 4.5.1/WebLogic Server**. If the Rational Bank Account sample was successfully deployed you should see the following line in the WebLogic Server window:

```
<EJB> 1 EJBs were deployed using .jar files
```

Note: If beans do not deploy, check the *<installdir>*\eval\cloudscape\data\cloudscape.log file.

Configuring Visual Cafe to Run the Sample Application

To run the Rational Bank Account sample EJB application in Visual Café:

1 Launch Visual Café 3.1 if it is not currently running.

2 Create a new Empty Project:

   a Click **File > New Project**….

   b Select Empty Project.

   c Click **OK**.

3 Click **Project > Options** and then click the **Directories** tab.

4 Click **New**, the button farthest to the left.

5 Click **file**.

6 Navigate to:

   Rational Test\QualityArchitect\Samples\ejb\bankacct\vc\RatlBankAcct.jar

   and click **Open**.

7 Click the **Project** tab.

8 In the Main Class box, type **RationalBankAcct.BankAcctClient**.

9 In the Program Arguments box, enter the following text:

   appserver=weblogic

10 Click **OK**.

   After this point, you can add account information and configure datapools and stub lookup tables.

Adding Account Information to the Rational Bank Account Sample

After the Rational Bank Account window opens (see *Configuring VAJ to Use the New Sample Database* on page 33 or *Configuring Visual Cafe to Run the Sample Application* on page 39), you need to create three or four savings accounts and make deposits to each account. Be sure to keep track of the generated account numbers and the balance in each account. You will need this information later when you create the datapool.

To create a new account:

1 Click **Open New Account**.

2 Enter the required account information and click **Execute Transaction**.

3 Write down the number of the new account.

To make a deposit:

1 Click **Deposit**.

2 Enter the account number that was returned when the account was created.

3 Enter the amount you wish to deposit.

4 Select **Savings**.

5 Click **Execute Transaction**.

Be sure to keep track of the account balance.

Generating Test Assets

This section shows you how to generate the various test assets you need to test EJBs with QualityArchitect. Test assets include test scripts, datapools, stubs, and lookup tables.

Generating EJB Test Scripts

QualityArchitect provides two ways to create EJB test scripts. The method you choose depends on the processes in place on your development and testing team and on the state of the component-under-test.

The recommended way to create test scripts is to model the component-under-test in Rational Rose and generate test scripts from the Rose model. However, if you have already built or partially built a component, you can:

- Reverse-engineer the component into Rose and generate test scripts from the model.
- Use the Session Recorder to create an XML log file and generate test scripts from the log file.

Generating Unit Test Scripts from a Rose Model

You can use the sample model that is included with the Rational Bank Account Sample Application to generate unit test scripts from Rose. For example, try generating a unit test for the `getBalance` method, which is part of the remote interface named `ExecuteTransaction`. This method is used to obtain the current balance from the specified account.

The `getBalance` method calls three methods from the session bean `ManageAccounts` in its code. The three methods are `getSavingsCustomerID`, `getSavingsBalance`, and `getCheckingBalance`. All these method take non-complex objects as parameters.

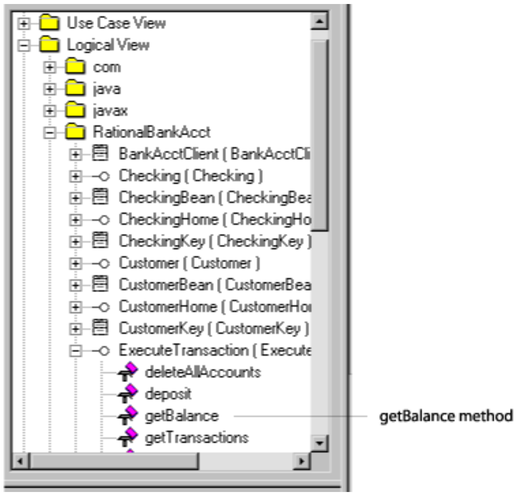
To generate the unit test:

1. If you haven't already done so, create a project with the Rational Administrator for maintaining your test assets.

   For details, see *Adding a Project* in the Administrator Help.

2. Start Rose and open the ratlbankacct.mdl model.

3. In Rose, right-click the `getBalance` method and click **Rational Test > Select Unit Test Template**.

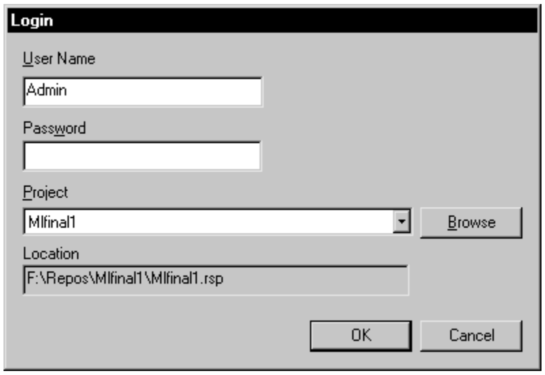
   
   Use Case View
Logical View
com
java
javax
RationalBankAcct
BankAcctClient (BankAcctCli
Checking (Checking)
CheckingBean (CheckingBea
CheckingHome (CheckingHo
CheckingKey (CheckingKey)
Customer (Customer)
CustomerBean (CustomerBea
CustomerHome (CustomerHo
CustomerKey (CustomerKey)
ExecuteTransaction (Execute
deleteAllAccounts
deposit
getBalance
getTransactions
getBalance method

4. Select the **websphere_remote.template** and click **Open** if you are working in a WebSphere environment. Select **weblogic_remote.template** and click **Open** if you are working in a WebLogic environment.

   QualityArchitect defaults to the last template chosen, so in the future you can skip this step if you plan to use the same template. For more information about templates see *Templates* on page 7.

5. In Rose, right-click the `getBalance` method again and click **Rational Test > Generate Unit Test.**

A message will be displayed, indicating that code generation is in progress, after which you will be prompted to log in to a Rational project.


Login

User Name: Admin

Password:

Project: Mlfinal1

Location: F:\Repos\Mlfinal1\Mlfinal1.rsp

6 Log in to the project and click **OK**.

Each project contains a datastore for storing test assets, such as datapools, lookup tables, and log files.

If this is the first time generating a script for a particular datastore, you will be prompted to select a directory in which to store your scripts.

7 Select a directory location and click **OK**.

QualityArchitect creates a directory hierarchy under the location you have chosen and saves the test script. The test script itself is assigned a name of the format *InterfacenameMethodname.* Thus, a script generated to test `getBalance` in the `ExecuteTransaction` interface would be named `ExecuteTransactiongetBalance.java`.

When code generation is complete, QualityArchitect reminds you to check the log file for details.

Note: QualityArchitect maintains an association between the test script directory you have chosen and the test assets that are stored in the project's test datastore.

For information about scenario testing, where you can test your business logic, see *Using EJB Scenario Tests to Test Transactions* on page 50.

Generating Test Scripts with the Session Recorder

If you have already built or partially built a component, you can use the Session Recorder to create an XML log file and generate test scripts from the log file. For details, see *Using the EJB Session Recorder* on page 60.

Creating a Datapool for the Unit Test

A *datapool* is a set of records that you can use to drive a test script. Datapool support is included automatically in each test script generated from Rose.

The following code fragment shows the datapool name and the parameter (column) names embedded in the test script:

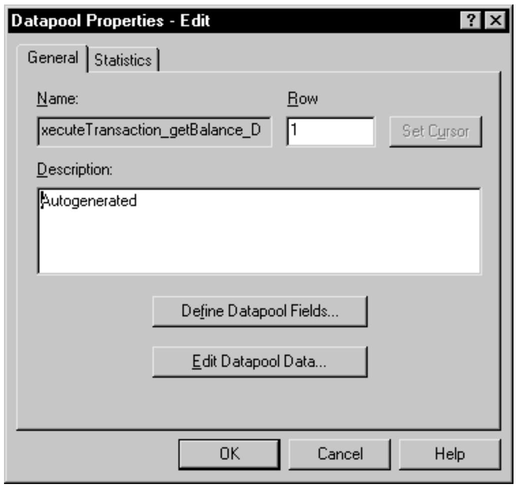
```
String sDPName = "ExecuteTransaction_getBalance_D";
dp.open(sDPName);
fRetval = dp.fetch();
while (fRetval)
{
   iDPCount = iDPCount + 1;

   // Retrieve values from Datapool for datatypes that we understand.
   accountID = dp.value("accountID").longValue();
   acctType = dp.value("acctType").toString();
   ExpectedReturn = dp.value(“expectedReturn”).getBigDecimal();
   sExpectedException = dp.value("expectedException").toString();
```

Datapool name

Column names are displayed here in boldface.

To create a datapool that you can use for testing the `getBalance` method:

1 In the Rose browser, right-click the `getBalance` method and click **Rational Test > Create Datapool**.



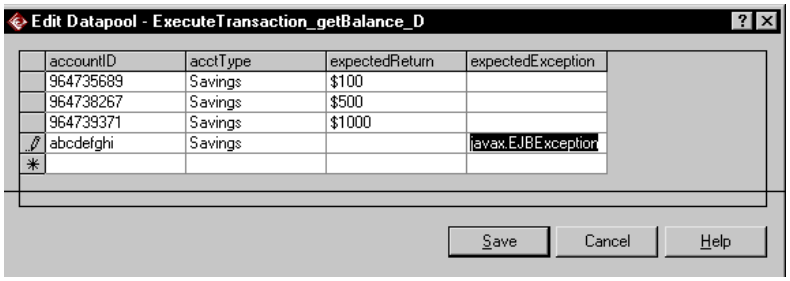
Name: xecuteTransaction_getBalance_D

Row: 1

Description: Autogenerated

QualityArchitect auto-generates a datapool named `ExecuteTransaction_getBalance_D`, using the parameters in the `getBalance` method (`accountID` and `acctType`) for the column names. It also creates a column for the expected return value of the method and the expected exception. The expected exception column should only be populated for rows containing input that elicit an exception from the method-under-test.

2 Click **Edit Datapool Data** and populate the datapool with several rows using the generated account numbers (IDs). Specify `Savings` as the account type, and enter the actual account balance in the `expectedReturn` column.



accountID	acctType	expectedReturn	expectedException
964735689	Savings	$100	
964738267	Savings	$500	
964739371	Savings	$1000	
abcdefghi	Savings		javax.EJBException

For more information about datapools, see *Datapools* on page 20, the *Test Script Services for Java* manual, and the online Help for Rational TestManager.

Generating Stubs for the Unit Test

With QualityArchitect you can create stubs for session beans and test any component that calls that session bean.

When you generate stubs for session beans, QualityArchitect creates Java source files for the home interface, the remote interface, and the implementation class itself. After generating stubs, you can deploy them on your application server, where they replace the real session beans.

Templates used for generating EJB session stubs include:

- Session_Bean.template
- Session_Home.template
- Session_Remote.template
- MethodBodyWithoutLookUp.template
- MethodBodyWithoutExceptions.template
- MethodBodyWithoutReturnValue.template
- MethodBody.template

Because the `getBalance` method calls methods in the `ManageAccounts` EJB, you can either generate a stub or run the tests directly against the actual `ManageAccounts` EJB.

To generate the stubs:

1 Right-click the **ManageAccountsBean** class in the Rose browser and click **Rational Test > Generate Stub**.

2 Select a directory for storing the stubs.

QualityArchitect generates stubs for:

- The remote interface, `ManageAccounts.java`
- The home interface, `ManageAccountsHome.java`
- The implementation class, `ManageAccountsBean.java`

Note: Stubs must be deployed on the same computer as the test script.

For a high-level overview of stubs, see *Stubs* on page 16.

Creating Lookup Tables

After you generate the stubs, create a lookup table for each method in the stub called by the method-under-test. In this case, you need to create two look up tables because `ExecuteTransaction.getBalance`, when called against a Savings account, calls two methods in the `ManageAccounts` bean—`getSavingsBalance` and `getCustomerID`.

Lookup tables are based on Rational datapool technology. Whereas a datapool is used to test inputs and expected behavior, a lookup table is used with stubs to simulate the behavior of an actual component.

To create a lookup table for the `getSavingsBalance` method in the `ManageAccounts` bean:

1 From the Rose browser, select the `getSavingsBalance` method in the `ManageAccounts` bean.

2 Click **Tools > Rational Test > Stubs > Create look-up table**.

3 Populate the table with real data, for example:

account ID	**Expected Return**	**Expected Exception**
Generated ID 1	*account balance*	
incorrect account ID		com.ibm.ejb.container.uncheckedException

4 Repeat these steps for `getCustomerID`.

At this point, you should be finished creating your tests assets, and you can start setting up your development environment in order to run the tests.

Importing Test Assets into VAJ

After you generate your test assets, you must add them to a project in your IDE, where you can run the tests.

If you are using IBM Visual Age for Java (VAJ), this means importing the test into the VAJ repository.

Note: For Visual Cafe, you simply add the file to an existing project or create a new project.

Importing Unit Tests Into VAJ

To import the unit test that you generated into the RationalBankAccount project in VAJ:

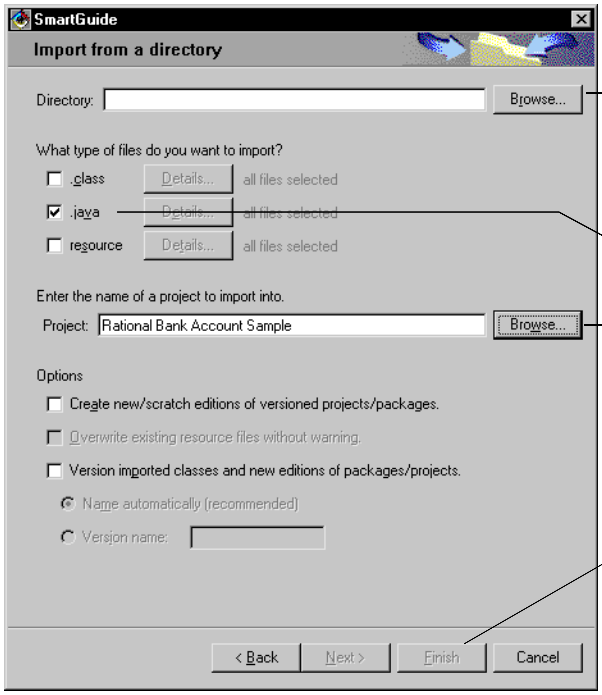
To import a generated unit test into VAJ:

1 Start VAJ.

2 Within the VAJ Workbench window, click the **Projects** tab.

3 Right-click anywhere in the window and click **Import...**.

4 When the SmartGuide dialog appears, select **Directory** as the import source and click **Next**.


SmartGuide

Import from a directory

Directory:

What type of files do you want to import?

[ ] .class — all files selected

[✓] .java — all files selected

[ ] resource — all files selected

Enter the name of a project to import into.

Project: Rational Bank Account Sample

Options

[ ] Create new/scratch editions of versioned projects/packages.

[ ] Overwrite existing resource files without warning.

[ ] Version imported classes and new editions of packages/projects.

[● Name automatically (recommended)]

○ Version name:

Click **Browse** and navigate to the test you generated in *Generating Unit Test Scripts from a Rose Model* on page 40. For details about locating test scripts, see *Storing Your Tests Scripts* on page 6.

Be sure to select **.java** as the type of file to import.

Click Browse and select the Rational Bank Account Sample Project.

Click Finish.

Note: When you import a script into VAJ, the script is compiled automatically.

Importing Stubs into VAJ

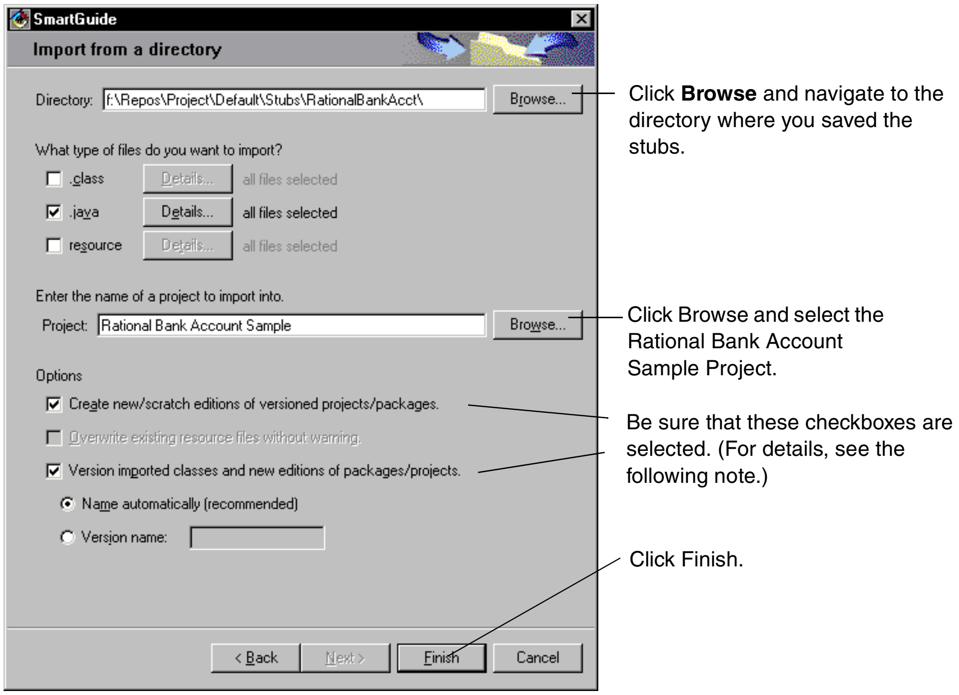
To import the stubs that you generated into the RationalBankAccount project in the VAJ repository.

1 Start VAJ if it is not already started.

2 Within the VAJ Workbench window, click the **Projects** tab.

3 Right-click anywhere in the window and click **Import…**.

4 When the SmartGuide dialog appears, select **Directory** as the import source and click **Next**.


SmartGuide

Import from a directory

Directory: f:\Repos\Project\Default\Stubs\RationalBankAcct\

What type of files do you want to import?

☐ .class — all files selected

☑ .java — all files selected

☐ resource — all files selected

Enter the name of a project to import into.

Project: Rational Bank Account Sample

Options

☑ Create new/scratch editions of versioned projects/packages.

☐ Overwrite existing resource files without warning.

☑ Version imported classes and new editions of packages/projects.

● Name automatically (recommended)

○ Version name:

Click **Browse** and navigate to the directory where you saved the stubs.

Click Browse and select the Rational Bank Account Sample Project.

Be sure that these checkboxes are selected. (For details, see the following note.)

Click Finish.

Note: Be sure to select the **Create new/scratch editions of versioned projects/packages** and **Version imported classes and new editions of versioned projects/packages** check boxes. Doing so lets you roll back to a known version of the software and thus switch between a stubbed test environment and a non-stubbed test environment.

To roll back to a previous version:

1 Shut down the EJB servers.

2 Right-click on the RationalBankAcct package and click **Replace with > Another Edition menu**.

Executing Test Scripts

This section describes how you execute your test scripts from VAJ and Visual Cafe.

Note: Before you can execute a test script, you may need to edit the `hostName` and `portNumber` variables for your particular, remote application server. These variables are declared in the `getInitialContext()` method in your script and in the template used to generate the script. By default, `localhost` is used if your application server is installed locally.

```
private InitialContext getInitialContext() throws NamingException {
      InitialContext initialContext= null;
      Properties p = new Properties();
      StringcontextFactory=
"com.ibm.ejs.ns.jndi.CNInitialContextFactory";
      Stringurl= "IIOP:///";
      String portNumber = null;
      String hostName = "localhost";
```

Executing Test Scripts from VAJ

To execute the test from VAJ:

1 Start the EJB servers.

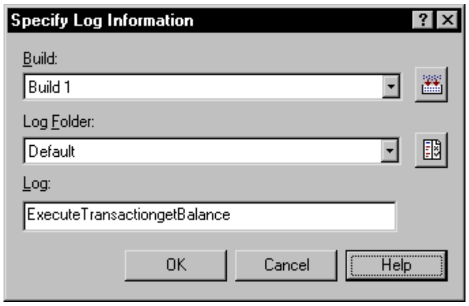
  See *Configuring VAJ to Use the New Sample Database* on page 33 for details on how to start the EJB servers.

2 Right-click on the generated test script `ExecuteTransactiongetBalance` in the VAJ Project window and click **Run > Check Classpath**.

3 Click **Compute Now** to add the path of the generated test script to the ClassPath.

4 Right-click on the generated test script `ExecuteTransactiongetBalance` in the VAJ Project window and click **Run > Run main**.

The Specify Log Information dialog box opens as follows:



Build: Build 1

Log Folder: Default

Log: ExecuteTransactiongetBalance

5 Accept the defaults in the Specify Log Information dialog box and click **OK**.

Click **Help** for more information about the Specify Log Information dialog box.

6 View the test results in the Rational TestLog viewer.

The log should contain entries from the stub, indicating the parameters received and values returned.

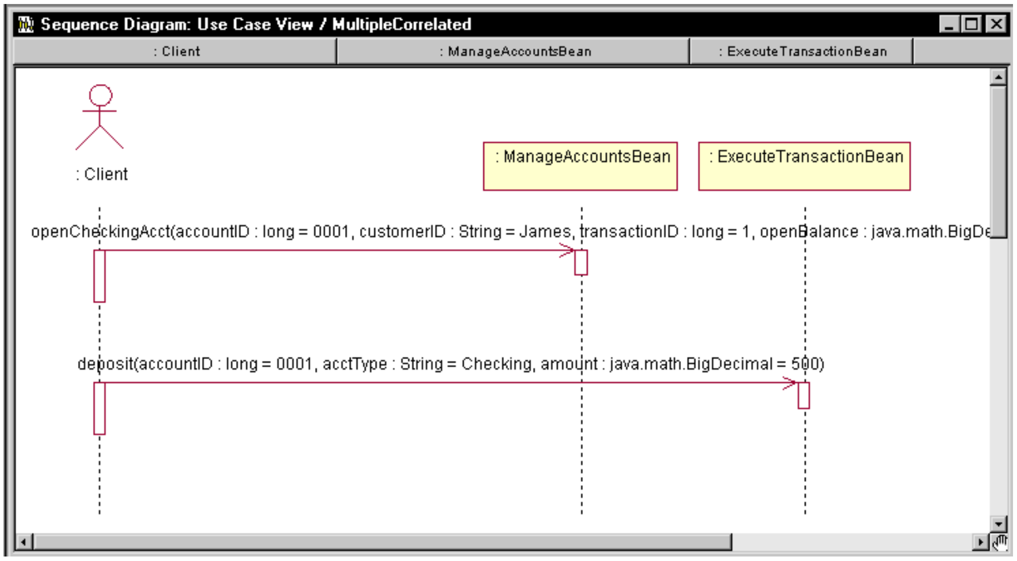
Click **Help** for more information about the TestLog viewer.

Executing Test Scripts from Visual Cafe

After you have added the required JAR files (see *Requirements for EJB Testing* on page 29), executing test scripts from Visual Cafe is simply a matter of adding the test scripts to an existing or new project and clicking **Project > Execute**.

Using EJB Scenario Tests to Test Transactions

Scenario tests use Rose interaction diagrams to test transactions. To try out this feature, you can generate a scenario test for one of the sequence diagrams that are included with the Rational Bank Account sample application.


Sequence Diagram: Use Case View / MultipleCorrelated
: Client
: ManageAccountsBean
: ExecuteTransactionBean
: Client
: ManageAccountsBean
: ExecuteTransactionBean
openCheckingAcct(accountID : long = 0001, customerID : String = James, transactionID : long = 1, openBalance : java.math.BigDe
deposit(accountID : long = 0001, acctType : String = Checking, amount : java.math.BigDecimal = 500)

When you generate a scenario test, QualityArchitect prompts you to insert a verification point for each message in your interaction diagram. To add a database verification point, you will need a database, and you will need to know the fully qualified path of your JDBC driver and the JDBC URL, which also includes the name of the database. For information on setting up the database for the sample application, see *The Rational Bank Account Sample Application* on page 30.

To generate a scenario test:

1 Right-click in an active interaction diagram and click **Rational Test > Select Scenario Test Template.**

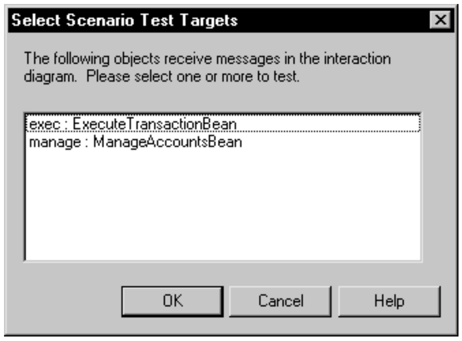
2 Expand either the WebSphere folder or the WebLogic folder and select either the **websphere_scenario template** or **weblogic_scenario template**.

3 Click **Open**.

4 Right-click in the interaction diagram and click **Rational Test > Generate Scenario Test.**

5 In the Select Scenario Test Targets dialog box, select the scenario test targets, that is, the receiver objects (where the arrows are pointing).

You can select one or more objects to test.

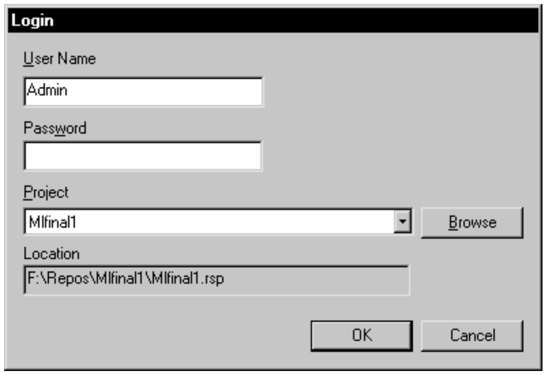

Select Scenario Test Targets

The following objects receive messages in the interaction diagram. Please select one or more to test.

exec : ExecuteTransactionBean
manage : ManageAccountsBean

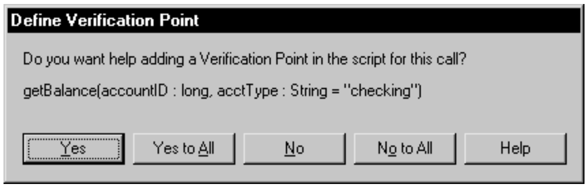
6 Click **OK**.

7 If prompted, log in to a project and click **OK**.


Login

User Name: Admin
Password:
Project: Mlfinal1
Location: F:\Repos\Mlfinal1\Mlfinal1.rsp

8 In the Define Verification Points dialog box, click **Yes** to add a verification point for the first message in the diagram—`getBalance`.


Define Verification Point

Do you want help adding a Verification Point in the script for this call?

getBalance(accountID : long, acctType : String = "checking")

9 In the Select Verification Point Type dialog box, select a verification point type and click **OK**.

For this release, select the database verification point type—`DatabaseVP`.

10 At this point, the Query Builder wizard starts. Use the Query Builder to connect to the database and to define a Select statement that can be used to query the database. For more information about the Query Builder, see *Using the Java Query Builder to Add Verification Points* on page 53.

11 Repeat Steps 8 and 9 for each message in the diagram.

12 When you reach the last message, you are prompted to add a verification point at the end of the scenario. Click **Yes**.

13 Select a directory to store the tests in and click **OK**.

Note: You can also start the scenario test generator by right-clicking on a diagram in the Rose browser and then clicking **Rational Test > Generate Scenario Test**. However, when you generate code by right-clicking on a diagram name in the Rose browser, code generation always proceeds using the active diagram—the one that is open in a window—not necessarily the diagram that you clicked on.

Using the Java Query Builder to Add Verification Points

The QualityArchitect Query Builder is a tool that helps you connect to and interact with databases for the purpose of defining database verification points. The Query Builder uses a wizard-like interface that lets you build a query one step at a time. Once built, the query is used with a database verification point.

To understand more about the Query Builder, consider what happens if you generate a scenario test for the Multiple Correlated sequence diagram in the sample application. (See *Using EJB Scenario Tests to Test Transactions* on page 50). This sequence diagram contains two messages:

- `openCheckingAcct`
- `deposit`

In testing this scenario, you could choose to create a verification point for each message. The first verification point could be used to verify that an account was opened and that the opening balance is as expected. The second verification point could be used to verify the results of a deposit to this account.

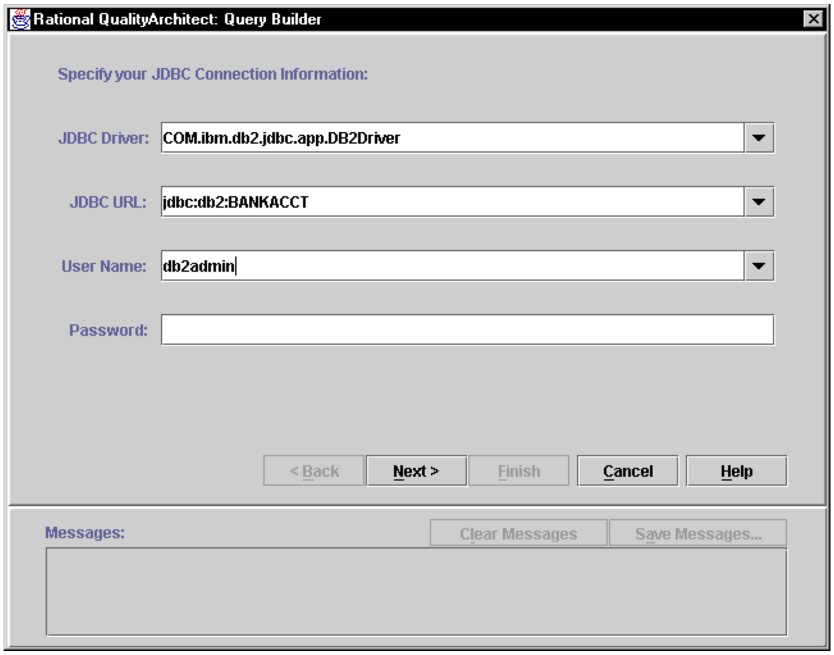
To design the query, you must:

- Connect to a database via JDBC
- Design a SQL statement
- View the SQL query results
- Verify the specified SQL query settings

Connecting to the Database via JDBC

The first step involved with building a custom SQL query is connecting to the database and entering the required JDBC information.

When the Query Builder starts, specify the JDBC Driver, the JDBC URL, a user name, and password and click **Next**.


Rational QualityArchitect: Query Builder
Specify your JDBC Connection Information:
< Back
Next >
Finish
Cancel
Help
Messages:
Clear Messages
Save Messages...

JDBC Driver: COM.ibm.db2.jdbc.app.DB2Driver

JDBC URL: jdbc:db2:BANKACCT

User Name: db2admin

Password:

JDBC Driver

The JDBC Driver text is the fully qualified class name to the Java JDBC driver class that was written for the specific DBMS you would like to connect to. Here are some examples of JDBC Driver text for some common environments:

Environment	JDBC Driver Text
WebSphere/DB2	COM.ibm.db2.jdbc.app.DB2Driver
WebLogic/SQL Server	weblogic.jdbc.mssqlserver4.Driver
Any ODBC data source	sun.jdbc.odbc.JdbcOdbcDriver

JDBC URL

The JDBC URL provides a way of identifying a database to the driver. The standard syntax for JDBC URLs is as follows:

```
jdbc:<subprotocol>:<subname>
```

The three parts of a JDBC URL are broken down as follows:

Part of URL	Description
jdbc	The jdbc protocol. The protocol is always jdbc.
subprotocol	Contains the name of the driver or the name of a database connectivity mechanism, which may be supported by one or more drivers. A prominent example of a subprotocol name is "odbc", which has been reserved for URLs that specify ODBC-style data source names.
subname	Used to identify the database. The subname can vary, depending on the subprotocol, and it can have a subsubname with any internal syntax the driver writer chooses.

Here are some examples of JDBC URLs for some common environments:

Environment	JDBC Driver Text
WebSphere/DB2	jdbc:db2:BANKACCT
WebLogic/SQL Server	jdbc:weblogic:mssqlserver4:CQSMV
Any ODBC data source	jdbc:odbc:nwind

User Name

The User Name text is the name of the user who has access rights to the specified database.

Password

The Password text is the password that is associated with the database user.

Designing a Custom Query Statement

After you connect to the database, you can design the custom SQL query statement that will be used to retrieve specific data from the database.

For example, in testing `openCheckingAcct`, you could construct a Select statement that returns an account ID, a customer ID, and a balance from the Checking table.

If you are familiar with SQL syntax and are familiar with the schema of the database you are connecting to, you can simply enter your custom SQL query statement in the SQL Text box.

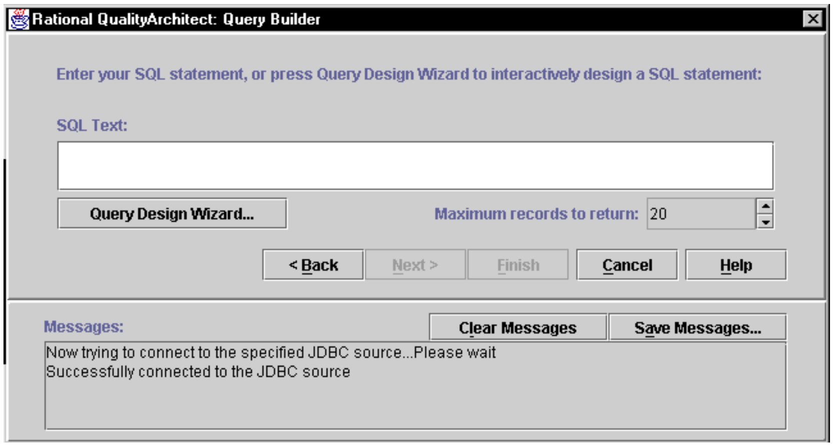
Once you are satisfied with your custom SQL query statement, click **Next** to apply the SQL query to the connected database.

Using the Query Design Wizard

If you are not familiar with SQL syntax or are not familiar with the schema of the database you are connecting to, you can use the Query Design Wizard to interactively walk you through the design of your custom SQL query statement. The Query Design Wizard helps you easily create complex SQL query statements by taking you step-by-step through the design process.

To use the Query Design Wizard:

1 Click the **Query Design Wizard** button.


Rational QualityArchitect: Query Builder

Enter your SQL statement, or press Query Design Wizard to interactively design a SQL statement:

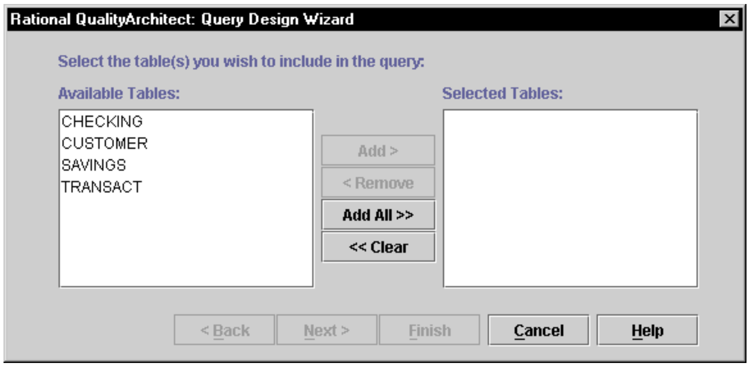
SQL Text:

Maximum records to return: 20

Messages:

```
Now trying to connect to the specified JDBC source...Please wait
Successfully connected to the JDBC source
```

2 Select the tables you want to query and click **Next**.



Rational QualityArchitect: Query Design Wizard

Select the table(s) you wish to include in the query:

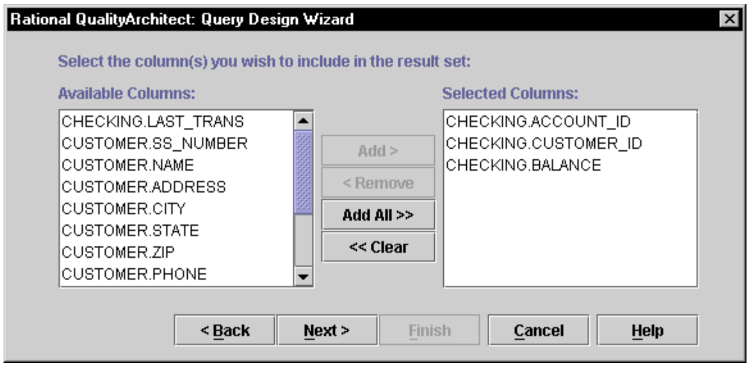
Available Tables:

CHECKING
CUSTOMER
SAVINGS
TRANSACT

Selected Tables:

To select desired tables, just click on the table names in the Available Tables list and click **Add**. To select all of the tables in the list, click **Add All**.

3 Select the columns to include in the result set and click **Next**:



Rational QualityArchitect: Query Design Wizard

Select the column(s) you wish to include in the result set:

Available Columns:

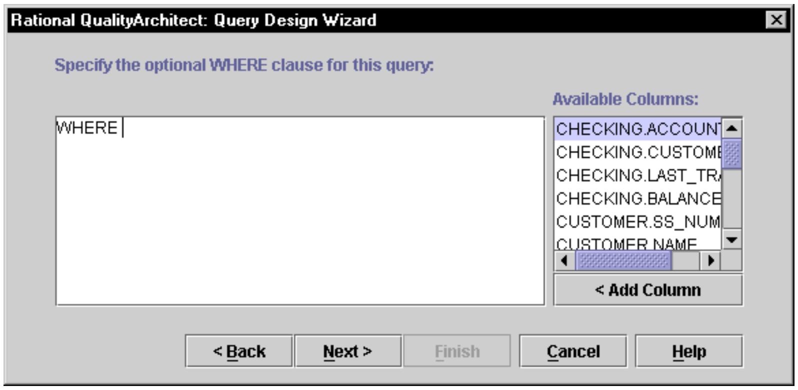
CHECKING.LAST_TRANS
CUSTOMER.SS_NUMBER
CUSTOMER.NAME
CUSTOMER.ADDRESS
CUSTOMER.CITY
CUSTOMER.STATE
CUSTOMER.ZIP
CUSTOMER.PHONE

Selected Columns:

CHECKING.ACCOUNT_ID
CHECKING.CUSTOMER_ID
CHECKING.BALANCE

Column names are listed in *TableName.ColumnName* format so that you can easily identify which columns exist in which tables.

4 Enter an optional WHERE clause for the query and click **Next**.


Rational QualityArchitect: Query Design Wizard

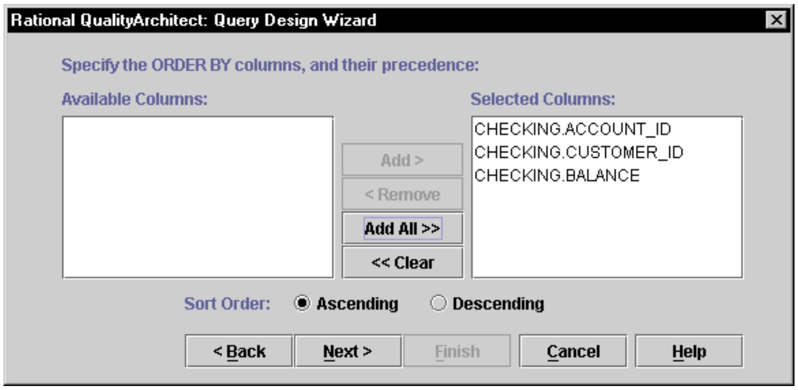
Specify the optional WHERE clause for this query:

WHERE

Available Columns:
CHECKING.ACCOUN
CHECKING.CUSTOME
CHECKING.LAST_TR
CHECKING.BALANCE
CUSTOMER.SS_NUM
CUSTOMER.NAME

The WHERE clause allows you to specify a search condition that will restrict the returned query results.

5 Specify the ORDER in which you want to display the columns and their precedence and click **Next.**


Rational QualityArchitect: Query Design Wizard

Specify the ORDER BY columns, and their precedence:

Available Columns:

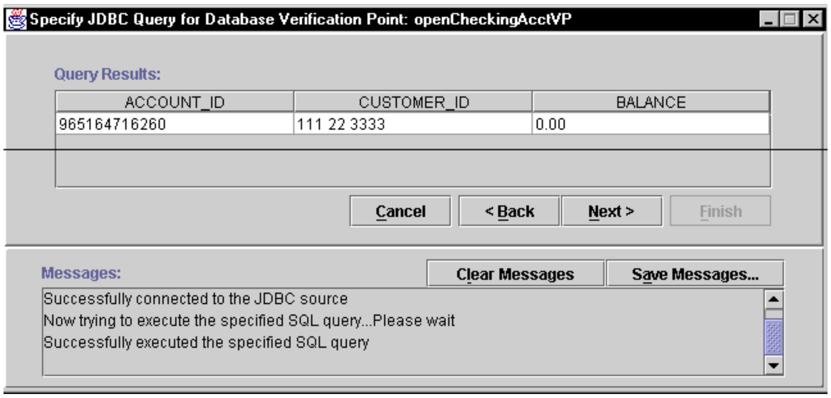
Selected Columns:
CHECKING.ACCOUNT_ID
CHECKING.CUSTOMER_ID
CHECKING.BALANCE

Sort Order: [✓ Ascending] Descending

6 Verify the SQL statement, make any edits as needed, and click **Finish** to accept the SQL query statement and exit the Query Design Wizard.

Viewing and Verifying the SQL Query Results

When the custom SQL query has been successfully executed on the connected database, the query results are displayed in the Query Results table. The columns of the table correspond to the columns that you included in the SQL query in the SELECT clause.


Specify JDBC Query for Database Verification Point: openCheckingAcctVP
Cancel
< Back
Next >
Finish
Clear Messages
Save Messages...

Query Results:

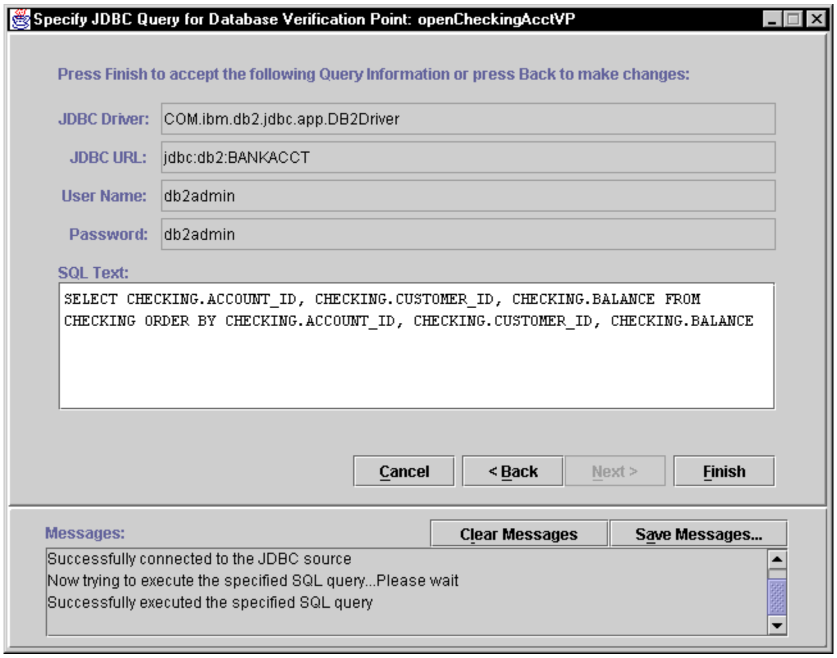
ACCOUNT_ID	CUSTOMER_ID	BALANCE
965164716260	111 22 3333	0.00

Messages:

```
Successfully connected to the JDBC source
Now trying to execute the specified SQL query...Please wait
Successfully executed the specified SQL query
```

1 If you are satisfied with the query results, click **Next**. If you need to make changes to the SQL query statement, click **Back**.

2 Click **Finish** to confirm the information you entered:


Specify JDBC Query for Database Verification Point: openCheckingAcctVP
Cancel
< Back
Next >
Finish
Clear Messages
Save Messages...

Press Finish to accept the following Query Information or press Back to make changes:

JDBC Driver: COM.ibm.db2.jdbc.app.DB2Driver

JDBC URL: jdbc:db2:BANKACCT

User Name: db2admin

Password: db2admin

SQL Text:

```
SELECT CHECKING.ACCOUNT_ID, CHECKING.CUSTOMER_ID, CHECKING.BALANCE FROM
CHECKING ORDER BY CHECKING.ACCOUNT_ID, CHECKING.CUSTOMER_ID, CHECKING.BALANCE
```

Messages:

```
Successfully connected to the JDBC source
Now trying to execute the specified SQL query...Please wait
Successfully executed the specified SQL query
```

3 After you finish creating the query for a scenario test, the script generator asks if you want to create verification points for each additional message in the diagram. If you choose to, create a database verification for the `deposit` message.

After you finish entering database verification points, the scenario test script is generated. A sample verification point is listed in the script as follows:

```
// A verification point may be automatically inserted below.

String svp1JDBCdriver = dp.value("svp1JDBCdriver").toString();

String svp1JDBCurl = dp.value("svp1JDBCurl").toString();

String svp1JDBCuser = dp.value("svp1JDBCuser").toString();

String svp1JDBCpassword = dp.value("svp1JDBCpassword").toString();

String svp1SQL = dp.value("svp1SQL").toString();

String svp1VPname = dp.value("svp1VPname").toString();

DatabaseVP vp1openCheckingAcctVP = new DatabaseVP( "svp1VPname",
svp1SQL, svp1JDBCuser, svp1JDBCpassword, svp1JDBCdriver,
svp1JDBCurl);

vp1openCheckingAcctVP.performTest(null);
```

For more information about coding verification points, see the *Rational Test Script Services for Java* manual.

Using the EJB Session Recorder

The Session Recorder is a tool that lets you visually connect and interact with EJBs. As you execute transactions against the component, interaction data is recorded and stored in an external XML file. Afterwards, you can use the XML Script Generator to generate test scripts for testing the EJB.

Before working with the Session Recorder, see *Requirements for EJB Testing* on page 29 for information about any required software.

The basic steps for using the Session Recorder are as follows:

1 Start the Session Recorder.

2 Connect to the JNDI Naming Service and select a deployed EJB.

This returns the EJB's home interface.

3 Select a method on the home interface and enter parameter names and values for the method.

4 Invoke the method.

This returns the EJB's remote interface.

5. Select a method on the remote interface and enter parameter names and values for the method.

   To enter parameter names and values for the EJBs installed with QualityArchitect, for example, you will need to examine the Method Specifications in Rose or review the EJB's methods in your IDE.

6. Invoke the method.

7. View the XML log by clicking **View > Current XML Log**.

8. Generate a test script from the XML log.

Session Recorder Requirements

The EJB Session Recorder is dependent on the following JAR files:

- Rational Test Services (rational_ct.jar and rttsjava.jar)
- XML Script Generator (scriptgen_ct.jar)
- Swing v.1.1.1 (swingall.jar)
- Xerces XML Parser v.1.2 (xerces.jar)
- Java Collections v.1.1 (collections.jar)
- JavaHelp v.1.1 (jh.jar)

To enable the Session Recorder, these JAR files must be added to your classpath.

The EJB Session Recorder is also dependent on the required application server EJB classes and the home and remote classes for the deployed EJBs. Consult your application server documentation for information about the required application server classes.

The EJB Session Recorder is compatible with the following JDKs/JREs: v.1.1.7 to v.1.2.2.

The name of the JAR file for the EJB Session Recorder itself is ejbtestclient_ct.jar.

Starting the Session Recorder

There are several ways to start the Session Recorder:

- From IBM Visual Age for Java
- From Visual Cafe
- From the command line
- From the QualityArchitect toolbar

Starting the Session Recorder from Visual Age for Java 3.0x

Before You Start

Before you start setting up the EJB Session Recorder in VAJ v.3.0x, make sure the IBM EJB Development Environment feature and IBM WebSphere Test Environment feature have been added. To do this:

1. Click **File > QuickStart** from the main VAJ menu.
2. Click **Features** in the left-hand box and **Add Features** in the right-hand box.
3. Click **OK**.

   A dialog will be displayed with a list of features.
4. Click **IBM EJB Development Environment** and **IBM WebSphere Test Environment** and click OK.

   To make sure that these features were added successfully, make sure the EJB tab is one of the visible tabs in the Workbench window.

Creating a New Project

From the VAJ Workbench window, create a new project.

After you create the project, you will see the name of the new project in the current projects list.

Importing Swing Into the Project

1. Right click on the name of the project that you just created and click **Import**.
2. Make sure the Jar file option is selected and click **Next**.
3. Under **What types of files do you want to import**, make sure the **.class** option and **resource** option are checked.

4 Under **Options**, make sure **Create new/scratch editions of versioned projects/packages** is checked.

5 Click the **Browse** button and navigate to the installation directory for QualityArchitect (Rational\Rational Test\QualityArchitect).

6 Select swingall.jar and click **Open** in the File Open dialog.

7 Click **Finish**.

All of the class files from the JAR file will then be imported into the VAJ repository.

After **swingall.jar** is imported, an importing problems dialog will be displayed. The dialog essentially states that the following Macintosh Swing class:

```
com.sun.java.swing.plaf.mac.MacBorders.class
```

cannot be changed.

You can ignore these problems because they will not affect the EJB Session Recorder.

8 Click **OK** to close the problems dialog.

The Modify Palette dialog now appears. This dialog lets you specify which Swing classes you want to add to the visual palette.

9 Click **Cancel** to close this dialog.

Importing JavaHelp

The next JAR file to import is JavaHelp (jh.jar). Follow the steps in *Importing Swing Into the Project* on page 62 to import JavaHelp into the project. Be sure to select jh.jar.

When you click **Finish**, all of the class files from the JAR file will be imported into the VAJ repository.

Note: A status message will be displayed stating that 7 problems were found. These problems are caused because VAJ 3.0x uses JDK v. 1.1.7 and the minimum JDK required for JavaHelp is JDK v.1.1.8. The following is a list of the classes that are referenced by JavaHelp but are missing from JDK 1.1.7:

- java.awt.print.PageFormat
- java.awt.print.Printable
- java.awt.print.PrinterJob
- java.security.PrivelegedExceptionAction
- java.security.Permission

These missing classes will not affect the viewing of JavaHelp from the EJB Session Recorder in VAJ 3.0x.

Importing Xerces

The next JAR file to import is xerces.jar. Follow the steps in *Importing Swing Into the Project* on page 62. Be sure to select xerces.jar.

When you click **Finish**, all of the class files from the JAR file will be imported into the VAJ repository.

Note: A problems dialog will be displayed stating that **One or more classes were imported into pre-existing packages in other projects**. Three of the packages found in xerces.jar are shared by the IBM XML Parser. Ignore these problems because they will not affect the EJB Session Recorder. Click **OK** to close this dialog.

Importing the Remaining Jar Files from the QualityArchitect Directory

Repeat the previous steps to import the following JAR files from the QualityArchitect directory:

- collections.jar
- scriptgen_ct.jar
- rational_ct.jar
- ejbtestclient_ct.jar

Importing rttssjav.jar

The next JAR file to import is rttssjava.jar, which is part of Rational Test Services. Follow the steps in *Importing Swing Into the Project* on page 62. Be sure to select rttssjava.jar, which is located in the Rational Test directory, one directory above the QualityArchitect directory.

Importing Deployed EJBs

In order for the EJB Session Recorder to successfully connect to deployed EJBs in VAJ, you must import the home and remote interface classes for those EJBs into VAJ.

Checking the Classpath and Launching the Session Recorder

1. Expand the package named com.rational.test.ejbclient under the project you created by clicking on the + box next to the package name.
2. Right-click on the EJBSessionRecorder class and click **Run > Check Class Path**.

3 Click the **Compute Now** button to fill in all the package dependencies for the EJB Session Recorder.

4 Click **OK**.

5 Right-click on the EJBSessionRecorder class again and click **Run > Run main** to launch the Session Recorder.

Passing in Command Line Parameters (optional)

As an added feature, the JNDI Provider URL and Initial Context Factory can be passed in as command line parameters for the EJB Session Recorder.

To specify these parameters for the EJB Session Recorder:

1 Right click the EJBSessionRecorder class and click **Run > Check Class Path**.

2 When the project properties dialog opens, click the **Program** tab.

3 Enter the command line parameters in the Command line arguments text box.

An example for VAJ would be:

```
provider=t3://localhost:7001 initialcontext=com.ibm.ejs.ns.jndi.CNInitialContextFactory
```

Starting the Session Recorder from Visual Age for Java 3.5

To start the Session Recorder from VAJ 3.5:

1 Follow the steps described for VAJ 3.0x in *Before You Start* on page 62 and *Creating a New Project* on page 62.

2 Because Swing is included in VAJ3.5, you can skip the step *Importing Swing Into the Project* on page 62.

3 Follow the steps described for VAJ 3.0x in *Importing Xerces* on page 64.

4 Follow the steps described for VAJ 3.0x in *Importing the Remaining Jar Files from the QualityArchitect Directory* on page 64. Be sure to import the following JAR files:

- jh.jar
- collections.jar
- scriptgen_ct.jar
- rational_ct.jar
- ejbtestclient_ct.jar

5 Follow the steps described for VAJ 3.0x in *Importing rttssjav.jar* on page 64.

6 Expand the package named com.rational.test.ejbclient under the project you created by clicking on the + box next to the package name.

7 Right-click on the EJBSessionRecorder class and click **Run > Check Class Path**.

8 Click the **Compute Now** button to fill in all the package dependencies for the EJB Session Recorder.

9 If you are going to run the EJB Session Recorder under the IBM WebSphere Test Environment, you must click the **Edit** button and check **IBM WebSphere Test Environment**.

10 Click **OK**.

11 Right-click on the EJBSessionRecorder class again and click **Run > Run main** to launch the Session Recorder.

12 Optionally, follow the steps described for VAJ 3.0x in *Passing in Command Line Parameters (optional)* on page 65.

Starting the Session Recorder from Visual Cafe

In order for the EJB Session Recorder to successfully connect to deployed EJBs in Visual Cafe, the home and remote interface classes for those EJBs must be referenced in the Visual Café classpath.

In addition, the required application server classes must be referenced in the Visual Cafe classpath. Consult your application server documentation for information about the required application server classes.

To start the Session Recorder from Visual Cafe:

1 Create a new, empty project in Visual Cafe.

2 After the new project is created, click **Project > Options** from the main menu.

3 Click the **Project** tab and enter the following text in the **Main Class** text box:

```
com.rational.test.ejbclient.EJBSessionRecorder
```

4 Click the **Directories** tab and verify that **Input class files** is selected in the **Show directories for** combo box.

5 Click the **New** button (the button furthest to the left) in the Directories area.

6 Click the **file** button.

7 In the File Open dialog, navigate to the installation directory for QualityArchitect (Rational\Rational Test\QualityArchitect), select **swingall.jar** and click **Open**.

The imported JAR file will appear in the **Directories** list.

8 Repeat the JAR import instructions for the rest of the required JAR files:

- Rational_ct.jar
- Xerces.jar
- collections.jar
- Jh.jar
- Scriptgen_ct.jar
- Ejbtestclient_ct.jar
- rttssjava.jar (located under Rational Test, not QualityArchitect)

9 Click **Project > Execute** from the main menu to launch the EJB Session Recorder.

Passing in Command Line Parameters (optional)

As an added feature, the JNDI Provider URL and Initial Context Factory can be passed in as command line parameters for the EJB Session Recorder.

To specify these parameters for the EJB Session Recorder:

1 Click **Project > Options** from the main menu.

2 When the Project Options dialog opens, enter the command line parameters in the Program Arguments text box.

An example for Visual Cafe would be:

provider=t3://localhost:7001 initialcontext=weblogic.jndi.WLInitialContextFactory

Starting the Session Recorder from the Command Line

Before the EJB Session Recorder can be run from the command line, the following paths must be referenced on the System path:

- The path to the Java executable for your chosen JDK/JRE
- The path to the Rational QualityArchitect installation directory
- The path to the Rational Test directory

To set up the Session Recorder to run from the command line:

1 Type the following text as one long line at the command prompt:

```
java -classpath
"swingall.jar;jh.jar;xerces.jar;collections.jar;rational_ct.jar;rtt
ssjava.jar;scriptgen_ct.jar;ejbtestclient_ct.jar;<application
server classes><EJB interface classes>"
com.rational.test.ejbclient.EJBSessionRecorder
```

2 Fill in the <*application server classes*> tag with the required application server EJB classes. Consult the documentation for your application server for details.

3 Fill in the *<EJB interface classes>* tag with the location of the deployed EJB home and remote interface classes.

4 Press the ENTER key.

   This starts the JVM which launches the EJB Session Recorder.

Starting the Session Recorder from the Toolbar Console

Before you can start the Session Recorder from the toolbar, the following classes must be referenced in the user classpath:

- The home and remote interface classes for the deployed EJBs. These classes can be referenced in a directory or in a jar file.
- The required application server classes. Consult your application server documentation for information about the required application server classes.

To start the Session Recorder from the toolbar:

- Click the **Session Recorder** icon on the QualityArchitect toolbar.

Using the Session Recorder with the Sample Application

You can use the EJBs that have been installed with the sample application to try out the Session Recorder.

In this section you will:

1 Start a recording session.

2 Connect to an EJB.

3 Interact with the home interface.

4 Interact with the remote interface.

5 Insert a verification point.

6 View the XML log.

7 Generate a test script.

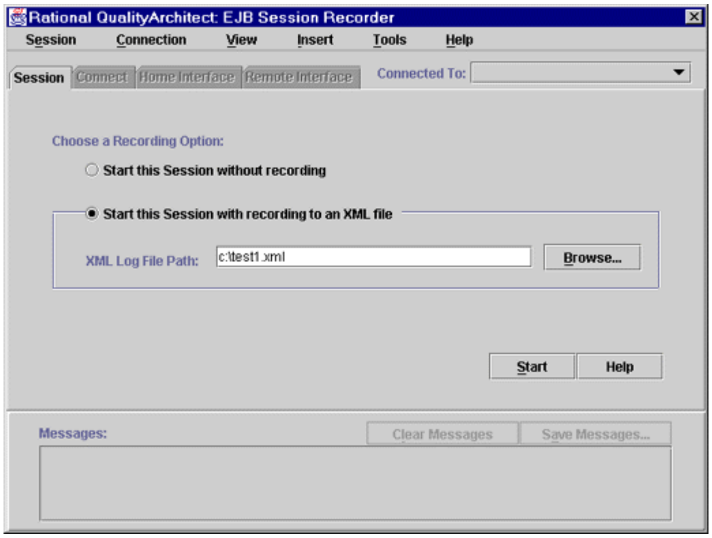
Before starting the Session Recorder, be sure to start your Application Server.

Starting a Recording Session

To start a recording session:

1 Start the Session Recorder, using one of the methods listed in *Starting the Session Recorder* on page 62.

When you start the Session Recorder, the first screen that is displayed is the Session panel.



2 Click **Start this Session with Recording to an XML** file.

3 Specify a path in which to store the XML log file.

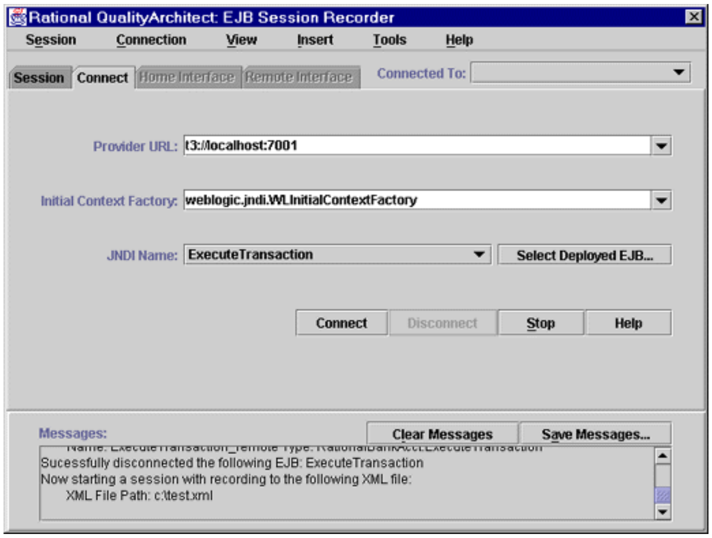
4 Click **Start**.

The Connect Panel is displayed.

Connecting to an EJB

Use the Connect Panel to enter the settings required to connect to JNDI (Java Naming and Directory Interface), to find the EJB stored in the Naming Service, and to return the home interface.

Application servers, such as IBM WebSphere and BEA WebLogic, may utilize a completely different Naming Service architecture. In most cases, you should be able to accept the default settings for your application server.



Provider URL: t3://localhost:7001

Initial Context Factory: weblogic.jndi.WLInitialContextFactory

JNDI Name: ExecuteTransaction

```
Sucessfully disconnected the following EJB: ExecuteTransaction
Now starting a session with recording to the following XML file:
      XML File Path: c:\test.xml
```

To connect to a deployed EJB and return its home interface:

1 Specify the **Provider URL**.

   The **Provider URL** is used to specify the location of the server that is used to provide the Naming Service.

   - The default URL for the WebSphere Naming Service server is iiop:///.
   - The default URL for the WebLogic Naming Service server is t3://localhost:7001.

   The general format for the **Provider URL** is:

   service://*host*:*port*/

   where

   - *service* refers to the name given to the Naming Service for the Application Server.
   - *host* is the host machine that the Naming Service is running on.
   - *port* refers to the specific port on the host machine that the Naming Service is listening to for requests.

2 Specify the **Initial Context Factory** for your application server.

To access a JNDI service provider, you need to create an initial context and pass it a context factory, which creates a context for a particular provider. The *context factory* is essentially a Java object that contains the JNDI information required by the Naming Service. Once the context is created, it provides client access to the Naming Service.

The default context factory for WebSphere is:

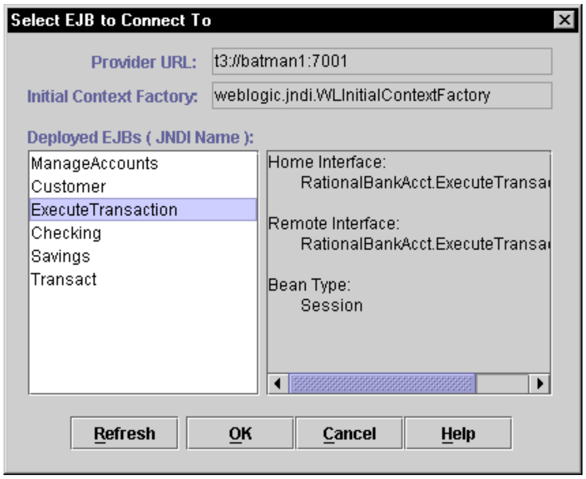
com.ibm.ejs.ns.jndi.CNInitialContextFactory

The default context factory for WebLogic is:

weblogic.jndi.WLInitialContextFactory

3 Click the **Select Deployed EJB** button.

This retrieves the list of deployed EJBs from the application server. In this case, select the `ExecuteTransaction` bean and click **OK**.



Provider URL: t3://batman1:7001

Initial Context Factory: weblogic.jndi.WLInitialContextFactory

Deployed EJBs (JNDI Name):

ManageAccounts
Customer
ExecuteTransaction
Checking
Savings
Transact

Home Interface:
RationalBankAcct.ExecuteTransa

Remote Interface:
RationalBankAcct.ExecuteTransa

Bean Type:
Session

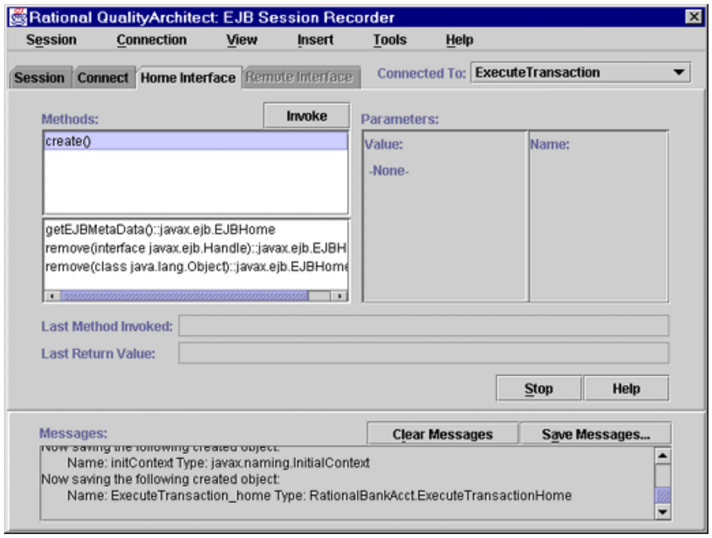
4 Click **Connect**.

This connects you to the JNDI services, which returns the deployed bean's home interface and displays the Home Interface panel.

Note: If there is a problem connecting to JNDI or retrieving the home interface, view the error information displayed in the Messages panel.

Interacting with the Home Interface

The Home Interface panel displays the public methods for the EJB’s home interface.


Rational QualityArchitect: EJB Session Recorder
Session Connection View Insert Tools Help
Session Connect Home Interface Remote Interface
Connected To: ExecuteTransaction
Methods:
Invoke
Parameters:
Value:
-None-
Name:
Last Method Invoked:
Last Return Value:
Stop
Help
Messages:
Clear Messages
Save Messages...

```
create()
```

```
getEJBMetaData()::javax.ejb.EJBHome
remove(interface javax.ejb.Handle)::javax.ejb.EJBH
remove(class java.lang.Object)::javax.ejb.EJBHome
```

```
Now saving the following created object:
    Name: initContext Type: javax.naming.InitialContext
Now saving the following created object:
    Name: ExecuteTransaction_home Type: RationalBankAcct.ExecuteTransactionHome
```

The Home Interface panel displays methods, parameters, and messages.

- The Methods list displays all of the public methods in the EJB’s home interface class.
- The Parameters pane displays all the required parameters for the selected home interface method.
- The Messages pane is used to display status information for invoked methods.

Invoking a Method on the Home Interface

To invoke a method on the home interface:

1. Verify that the `create()` method is selected in the **Methods** list.

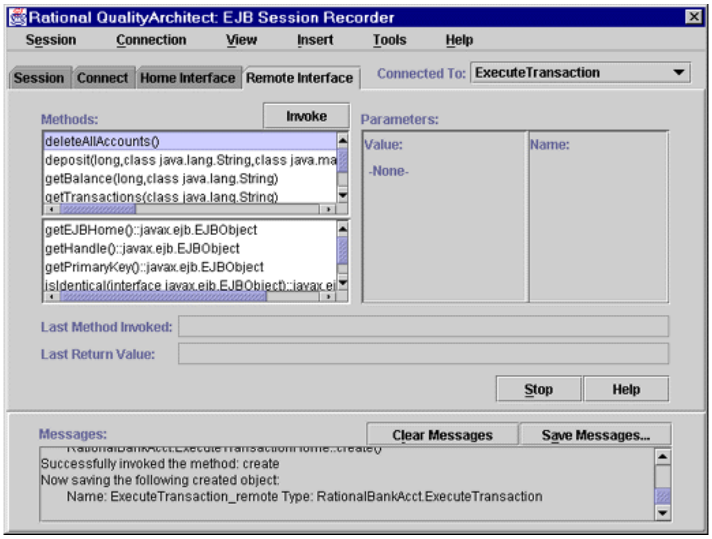
   There are no required parameters for the `create()` method.

2. Click **Invoke**.

   When you invoke the `create()` method on the home interface, the remote interface is returned and the Remote Interface panel is displayed.

Interacting with the Remote Interface

This panel is very similar to the Home Interface panel in that it displays methods, parameters, and messages.


Rational QualityArchitect: EJB Session Recorder
Session
Connection
View
Insert
Tools
Help
Session
Connect
Home Interface
Remote Interface
Connected To:
ExecuteTransaction
Methods:
Invoke
deleteAllAccounts()
deposit(long,class java.lang.String,class java.ma
getBalance(long,class java.lang.String)
getTransactions(class java.lang.String)
getEJBHome()::javax.ejb.EJBObject
getHandle()::javax.ejb.EJBObject
getPrimaryKey()::javax.ejb.EJBObject
isIdentical(interface javax.ejb.EJBObject)::javax.ej
Parameters:
Value:
-None-
Name:
Last Method Invoked:
Last Return Value:
Stop
Help
Messages:
Clear Messages
Save Messages...

```
RationalBankAcct.ExecuteTransactionHome::create()
Successfully invoked the method: create
Now saving the following created object:
        Name: ExecuteTransaction_remote Type: RationalBankAcct.ExecuteTransaction
```

- The Methods list contains all of the public methods for the EJB's remote interface. The declared methods are displayed in the top section, and the inherited methods are displayed in the bottom section.
- When you select a method, its required parameters are displayed in the Parameters pane.
- The Messages pane is used to display status information for invoked methods.

To invoke a method on the remote interface, select the method from the Methods list. If there are any parameters required to invoke the method, enter the desired values for the parameters in the Parameters pane. Then, click the **Invoke** button to execute the method.

Note: To invoke methods for the sample application's remote interface, you will need to know the arguments for each method. One way to obtain this information is to examine one of the supplied Rose models.

Invoking the openAccount() Method

For example, to invoke the `openAccount()` method on the `ExecuteTransaction` remote interface:

1 Click the `openAccount`() method from the **Methods** list.

2 Enter values for the required parameters, for example:

Values	**Names**
123 45 6789	ssNumber
Theadore Cleaver	name
1959 Wright Way	address
Burbank	city
California	state
98765	zip
512 399-5678	phone

Optionally, you can also enter names for these values. Names are only necessary if you plan on reusing parameters during the session.

3 Click **Invoke**.

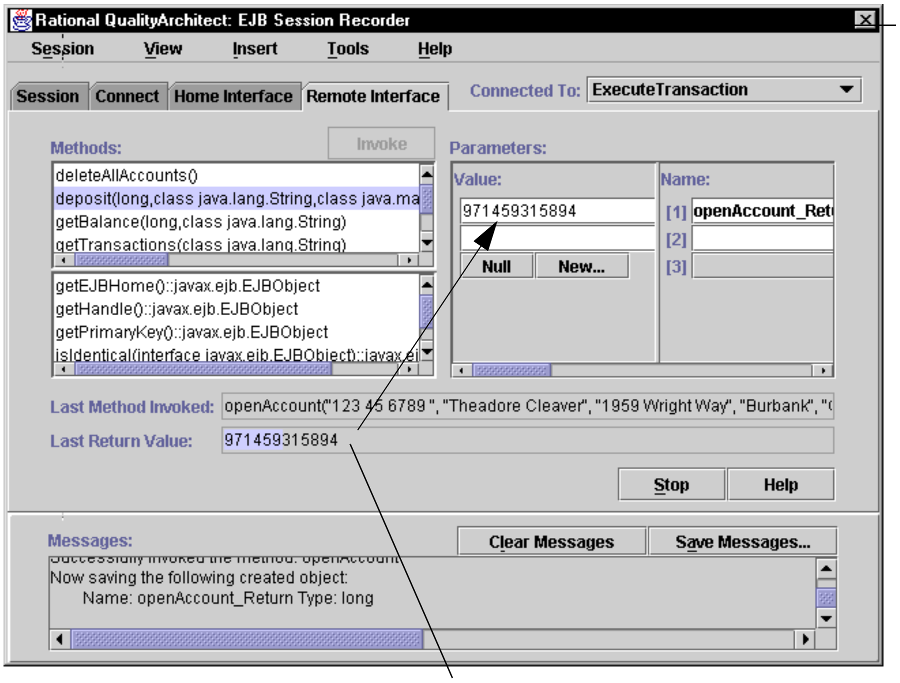
This operation returns an account ID in the **Last Return Value** box. The return value for `openAccount` is stored in a named variable called `openAccount_Return`.

Invoking the deposit() Method

To invoke the `deposit()` method:

1 Click the `deposit()` method from the **Methods** list.

2 Click on the value displayed in the **Last Return Value** box. Drag and drop the value on to the first **Parameter Value**.


Rational QualityArchitect: EJB Session Recorder
Session View Insert Tools Help
Session Connect Home Interface Remote Interface
Connected To: ExecuteTransaction
Methods:
Invoke
Parameters:
Value:
Name:
Null
New...
Stop
Help
Messages:
Clear Messages
Save Messages...

deleteAllAccounts()
deposit(long,class java.lang.String,class java.ma
getBalance(long,class java.lang.String)
getTransactions(class java.lang.String)

getEJBHome()::javax.ejb.EJBObject
getHandle()::javax.ejb.EJBObject
getPrimaryKey()::javax.ejb.EJBObject
isIdentical(interface javax.ejb.EJBObject)::javax.ej

Value: 971459315894
[1] openAccount_Ret
[2]
[3]

Last Method Invoked: openAccount("123 45 6789", "Theadore Cleaver", "1959 Wright Way", "Burbank", "(

Last Return Value: 971459315894

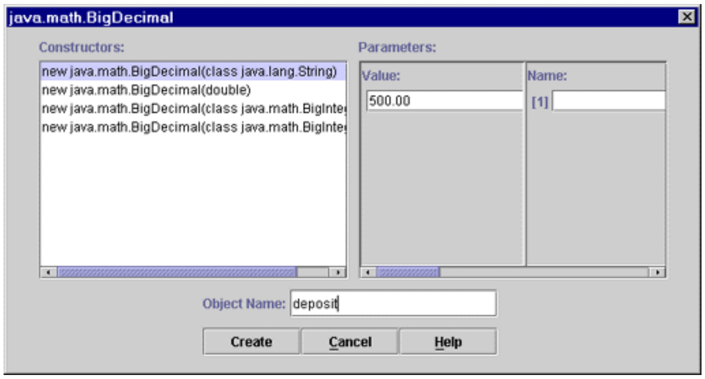
```
Successfully invoked the method: openAccount
Now saving the following created object:
      Name: openAccount_Return Type: long
```

Drag and drop the Last Return Value on to the first Parameter Value.

3 Type **Savings** for the second **Parameter Value** and then type **accountType** in the **Name** box.

4 Click **New**.

5 In the dialog box that is displayed, verify that the first constructor is selected and type a deposit amount, such as **$500**, in the first **Parameter Value** box.



new java.math.BigDecimal(class java.lang.String)
new java.math.BigDecimal(double)
new java.math.BigDecimal(class java.math.BigInte
new java.math.BigDecimal(class java.math.BigInte

Value: 500.00
[1]

Object Name: deposit

6 Optionally, type a name for the created object in the Object Name box.

The Object Name lets you assign a name to the created object. Named objects are stored in the program cache and can be reused in other methods.

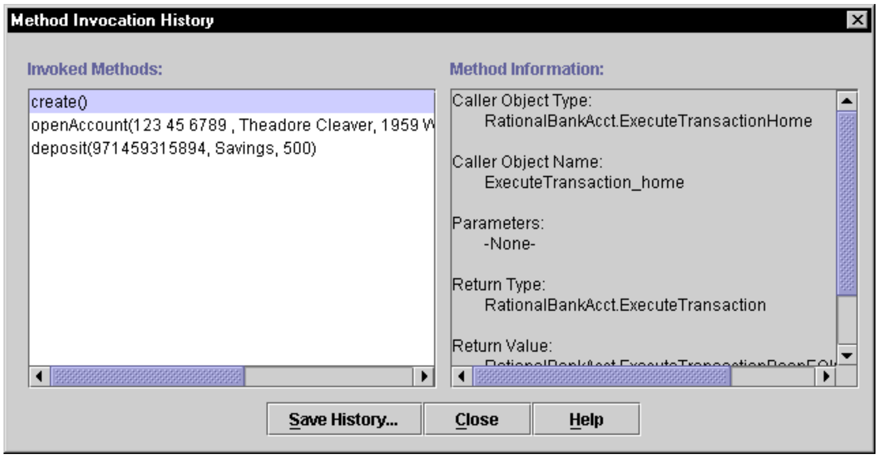
7 Click **Create**.

The deposit amount will now appear in the **Parameter Value** box. The named object will appear in the **Name** box.

8 Click **Invoke** to deposit the specified amount to the account.

9 Click **View > Method History** to see a history of the invoked methods.

The history includes methods that are successful, as well as those that have failed to execute.

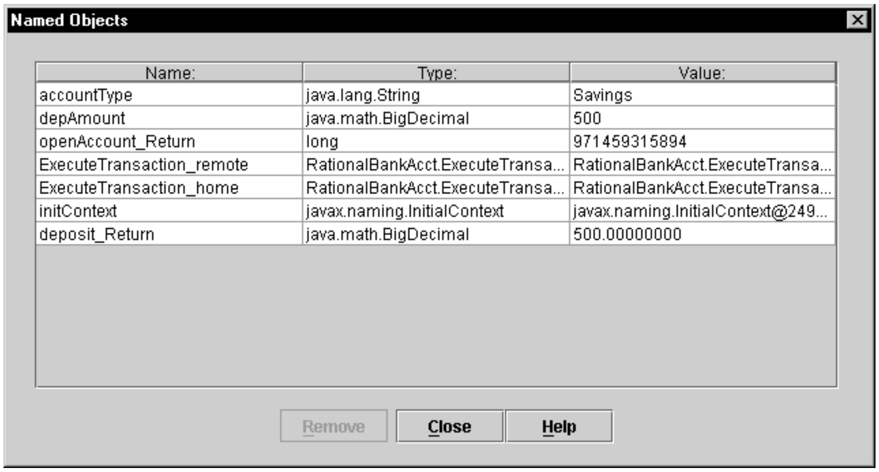


```
create()
openAccount(123 45 6789 , Theadore Cleaver, 1959 W
deposit(971459315894, Savings, 500)
```

```
Caller Object Type:
     RationalBankAcct.ExecuteTransactionHome

Caller Object Name:
     ExecuteTransaction_home

Parameters:
     -None-

Return Type:
     RationalBankAcct.ExecuteTransaction

Return Value:
```

When you finish viewing the Method History, click **Close**.

10 Click **View > Objects** to see a list of the named objects that were created. The named objects are the ones that can be reused during the session.



Name:	Type:	Value:
accountType	java.lang.String	Savings
depAmount	java.math.BigDecimal	500
openAccount_Return	long	971459315894
ExecuteTransaction_remote	RationalBankAcct.ExecuteTransa...	RationalBankAcct.ExecuteTransa...
ExecuteTransaction_home	RationalBankAcct.ExecuteTransa...	RationalBankAcct.ExecuteTransa...
initContext	javax.naming.InitialContext	javax.naming.InitialContext@249...
deposit_Return	java.math.BigDecimal	500.00000000

When you finish viewing the objects, click **Close**.

Invoking the getBalance() method

To invoke the `getBalance()` method:

1 Click the **getBalance()** method from the **Methods** list.

2 Right-click on the first Value box in the Parameters pane and select `openAccount_Return`.

The `openAccount_Return` object was created automatically when the `openAccount` method was invoked.

3 Right-click on the second Value box in the Parameters pane and select **accountType**.

4 Click **Invoke**.

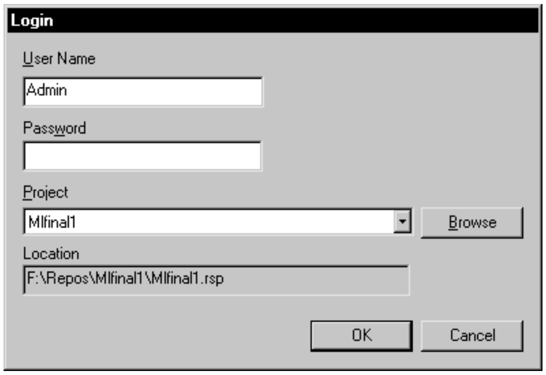
The current account balance should now appear in the **Last Return Value** box.

Inserting a Verification Point

To insert a verification point:

1 Click **Insert > Verification Point**.

2 If prompted, log in to a project and click **OK**.



Login

User Name: Admin

Password:

Project: MIfinal1

Location: F:\Repos\MIfinal1\MIfinal1.rsp

3 When the Select Verification Point Type dialog box is displayed, select **DatabaseVP**, or another type of verification point that you have implemented.

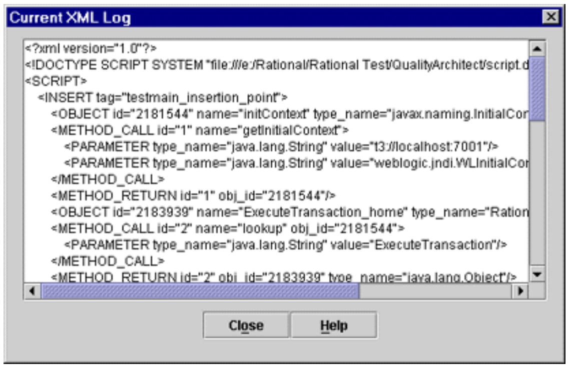
4 Type a name for the Verification Point and click **OK**.

5 At this point, the Query Builder wizard starts. Use the Query Builder to connect to the database and to define a Select statement that can be used to query the database. For more information about the Query Builder, see *Using the Java Query Builder to Add Verification Points* on page 53.

Viewing the XML Log

To view the XML log of the current session:

1 Click **View > XML Log**.



Current XML Log

```
<?xml version="1.0"?>
<!DOCTYPE SCRIPT SYSTEM "file:///e:/Rational/Rational Test/QualityArchitect/script.d
<SCRIPT>
  <INSERT tag="testmain_insertion_point">
    <OBJECT id="2181544" name="initContext" type_name="javax.naming.InitialCor
    <METHOD_CALL id="1" name="getInitialContext">
      <PARAMETER type_name="java.lang.String" value="t3://localhost:7001"/>
      <PARAMETER type_name="java.lang.String" value="weblogic.jndi.WLInitialCor
    </METHOD_CALL>
    <METHOD_RETURN id="1" obj_id="2181544"/>
    <OBJECT id="2183939" name="ExecuteTransaction_home" type_name="Ration
    <METHOD_CALL id="2" name="lookup" obj_id="2181544">
      <PARAMETER type_name="java.lang.String" value="ExecuteTransaction"/>
    </METHOD_CALL>
    <METHOD_RETURN id="2" obj_id="2183939" type_name="java.lang.Object"/>
```

2 When you finish viewing the log, click **Close**.

Generating a Test Script from the XML Log

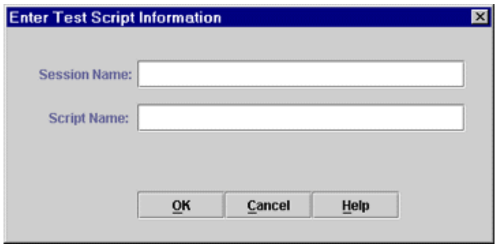
To stop the session and generate a test script:

1 Click **Stop**.

You will be asked whether or not you want to generate a test script from the XML log.

2 Click **Yes** to generate the test script.

Note: If you are not already logged into a project, you will be prompted to log in now. Then, you will be prompted to enter a Session Name and a Script Name.



3 Enter a name for the current session in the **Session Name** box.

4 Enter a name for the generated script in the **Script Name Box** and click **OK**.

The script will be saved in Test DataStore under recordedtests*<session name>**<scriptname.java>*.

Testing COM Components 4

This chapter contains the information you need to use Rational QualityArchitect to test COM-based component applications.

Topics include:

- Overview
- Requirements for testing COM components
- Working with the sample model
- Executing test scripts
- Using COM scenario tests to test transactions
- Using the OLE DB Query Builder to add verification points

Overview

With QualityArchitect, you can test COM components after they have been built, or you can test iteratively during the development process.

Testing Existing Objects

To test completed COM components, you can use the type library import tool in Rose. The type library import tool defines the appropriate interfaces, coclasses, and classes and the relationships among them. The structure for each COM object created in the model by the imported type library is the same as the structure created with the Rose ATL (ActiveX Type Library) object creation wizard.

Testing with Iterative Development

To test iteratively, you can use the Update Code feature of Rose to create new classes for your component and then round-trip the code you add to these classes into the model as you develop.

When you are ready to test, you import the type library for your component and model the transactions in interaction diagrams using the interfaces imported from the type library.

When you change your code, either by updating it from the model or directly, you simply refresh the type library information in the model by re-importing it.

Programming in Visual Basic

When you program in Visual Basic, VB masks the complexity of dealing with interfaces and coclasses. You use the class name both to instantiate objects and to call methods on those objects. VB creates a hidden interface, using your class name preceded by a leading underscore character.

QualityArchitect treats each test script generated for COM as a Visual Basic project. Each project consists of several files:

- *test*.vbp—The project file. This is what you open in Visual Basic.
- *test*.bas—The main program that calls the test script program in the .CLS file. Visual Basic requires a main program to begin execution.
- *test*.cls—The actual test script.
- *test*.res—A standard Visual Basic resource file used to store datapool configuration information. This file can be edited with the Visual Basic 6 resource file editor add-in. This file only needs to be edited if you plan to execute test scripts through Rational TestManager.

Every time you generate a unit test or a scenario test, QualityArchitect uses templates to produce these files.

Requirements for Testing COM Components

To test COM Components with QualityArchitect you need:

- Rational Rose
- Visual Basic 6.0
- A model that represents your COM interfaces and coclasses

  You can obtain this model by importing a type library.

In addition, you need to do one of the following:

- Add the file rc.exe to the User or System path, if it's not already there. By default, rc.exe is installed in two places:
  - *<Visual Studio Directory>*\Common\MSDev98\Bin
  - *<Visual Studio Directory>*\VB98\Wizards
- As an alternative, you can edit the file compile_resource.bat in the QualityArchitect directory and specify the full path to rc.exe on the command line in that file.

  To do this, make the following change:

  Before: `"RC.EXE" -v %1 > "%~dpn1.log"`

  After : `“<Visual Studio Directory>\VB98\Wizards\ RC.EXE” -v %1 > "%~dpn1.log"`

Working with the Sample Model

The installation procedure installs a sample Rose model—rqacomsample—that you can use to try out QualityArchitect. This model reflects a traditional transaction processing system that allows users to credit or debit their accounts on a server.

The rqacomsample model already contains an imported type library and a component associated with a Visual Basic source project.

Understanding the Component View

Rose's component view shows the physical pieces of software that are included in the model. Components of interest are:

- A COM object (RQACOMSample Ver 1.0) that is associated with the imported type library
- An optional ActiveX DLL ((RQACOMSample) that is associated with the Visual Basic source project

  This DLL is used for round-trip engineering.

Other components, such as Stdole and DAO, are included with COM.

Understanding the Logical View

The Logical View shows the packages, classes, interfaces, and operations in the model, such as:

- RQACOMSample (from COM)

  The package that is created when the type library is imported. (In the sample model, the type library has already been imported.) This package contains several COM interfaces—_Account, _UpdateReceipt, _GetReceipt, and _MoveMoney.

- RQACOMSample (from Reverse Engineered)

  The package containing objects used in round-trip engineering of the source code.

For script generation, QualityArchitect uses the COM package.

Generating Test Assets

This section shows you how to generate the various test assets you need to test COM components with QualityArchitect. Test assets include test scripts, datapools, stubs, and lookup tables.

Generating Unit Test Scripts from a Rose Model

You can use the rqacomsample sample model that is installed with QualityArchitect to generate unit test scripts from Rose. For example, try generating a unit test for the `Perform` method, which is part of the `_MoveMoney` interface.

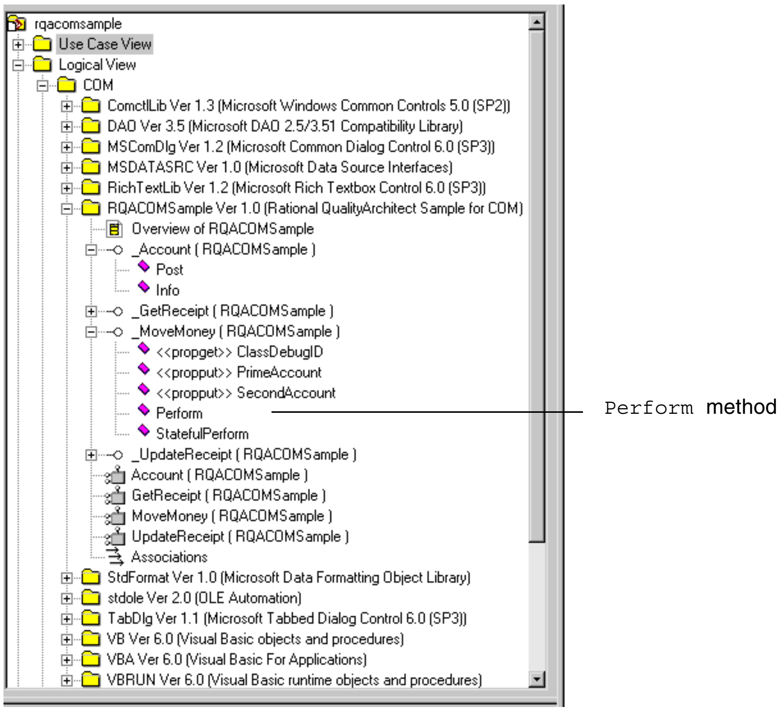
To generate the unit test:

1. If you haven't already done so, create a project with the Rational Administrator for maintaining your test assets.

   For details, see *Adding a Project* in the Administrator Help.

2. Start Rose and open the rqacomsample.mdl model.

3 In Rose, right-click the `Perform` method and click **Rational Test > Select Unit Test Template**.



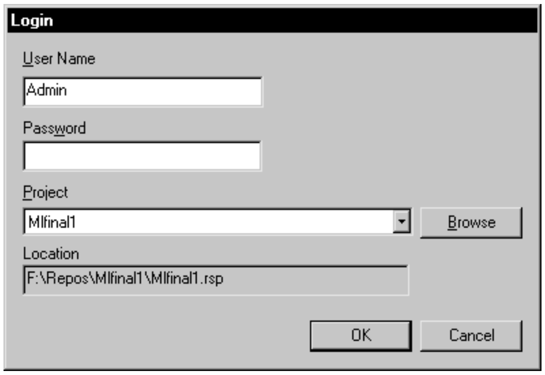
```
rqacomsample
  Use Case View
  Logical View
    COM
      ComctlLib Ver 1.3 (Microsoft Windows Common Controls 5.0 (SP2))
      DAO Ver 3.5 (Microsoft DAO 2.5/3.51 Compatibility Library)
      MSComDlg Ver 1.2 (Microsoft Common Dialog Control 6.0 (SP3))
      MSDATASRC Ver 1.0 (Microsoft Data Source Interfaces)
      RichTextLib Ver 1.2 (Microsoft Rich Textbox Control 6.0 (SP3))
      RQACOMSample Ver 1.0 (Rational QualityArchitect Sample for COM)
        Overview of RQACOMSample
        _Account ( RQACOMSample )
          Post
          Info
        _GetReceipt ( RQACOMSample )
        _MoveMoney ( RQACOMSample )
          <<propget>> ClassDebugID
          <<propput>> PrimeAccount
          <<propput>> SecondAccount
          Perform
          StatefulPerform
        _UpdateReceipt ( RQACOMSample )
        Account ( RQACOMSample )
        GetReceipt ( RQACOMSample )
        MoveMoney ( RQACOMSample )
        UpdateReceipt ( RQACOMSample )
        Associations
      StdFormat Ver 1.0 (Microsoft Data Formatting Object Library)
      stdole Ver 2.0 (OLE Automation)
      TabDlg Ver 1.1 (Microsoft Tabbed Dialog Control 6.0 (SP3))
      VB Ver 6.0 (Visual Basic objects and procedures)
      VBA Ver 6.0 (Visual Basic For Applications)
      VBRUN Ver 6.0 (Visual Basic runtime objects and procedures)
```

4 Select the **TestName.vbp** template and click **Open**.

For more information about templates see *Templates* on page 7.

5 In Rose, right-click the `Perform` method again and click **Rational Test > Generate Unit Test.**

A message will be displayed, indicating that code generation is in progress, after which you will be prompted to log in to a Rational project.


Login

User Name: Admin

Password:

Project: MIfinal1

Location: F:\Repos\MIfinal1\MIfinal1.rsp

6 Log in to the project and click **OK**.

Each project contains a datastore for storing test assets, such as datapools, lookup tables, and log files.

7 If this is the first time generating a script for a particular datastore, you will be prompted to select a directory in which to store your scripts.

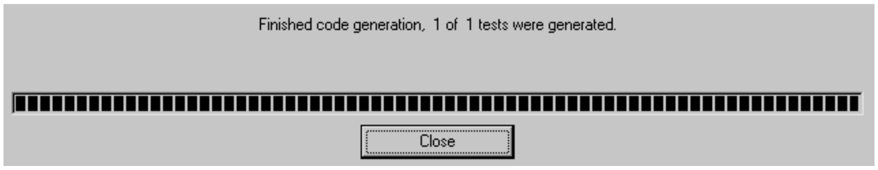
Select a directory location and click **OK**.

QualityArchitect creates a directory hierarchy under the location you have chosen and saves several files:

- MoveMoneyPerform.vbp
- MoveMoneyPerformMain.bas
- Perform.cls
- MoveMoneyPerform.res

The Visual Basic project file that is created (MoveMoneyPerform.vbp) is assigned a name of the format *InterfacenameMethodname.*

8 When code generation is complete, click **Close** to close the progress bar.


Finished code generation, 1 of 1 tests were generated.

Note: QualityArchitect maintains an association between the test script directory you have chosen and the test assets that are stored in the project's test datastore.

Creating a Datapool

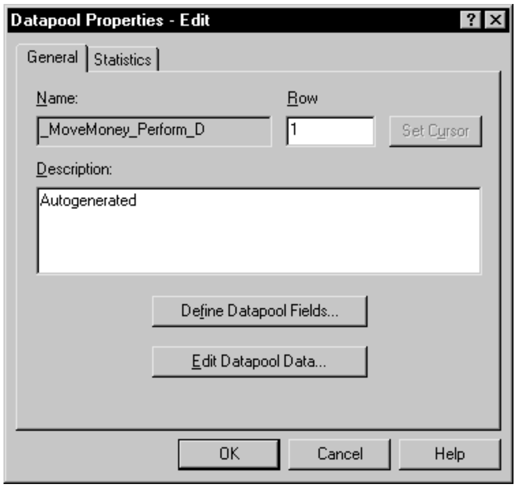
A *datapool* is a set of records that you can use to drive a test script. Datapool support is included automatically in each test script generated from Rose.

The following code fragment shows the datapool name and the parameter (column) names embedded in the test script:

```
'Open Datapool
   dp.Open "_MoveMoney_Perform_D"  ———————— Datapool name
   'Loop over datapool and perform test.
    While dp.Fetch
        'Keep counter of number of rows fetched.
        NumRows = NumRows + 1
        'Get the column data from the datapool.

    lPrimeAccount = dp.Value("lPrimeAccount")
    lSecondAccount = dp.Value("lSecondAccount")
    lAmount = dp.Value("lAmount")
    lTranType = dp.Value("lTranType")                 Column name
        expRet = dp.Value("expectedReturn")
        expErr = dp.Value("expectedError")
```

To create a datapool that you can use for testing the `Perform` method:

1 In the Rose browser, right-click the `Perform` method and click **Rational Test > Create Datapool**.


Datapool Properties - Edit

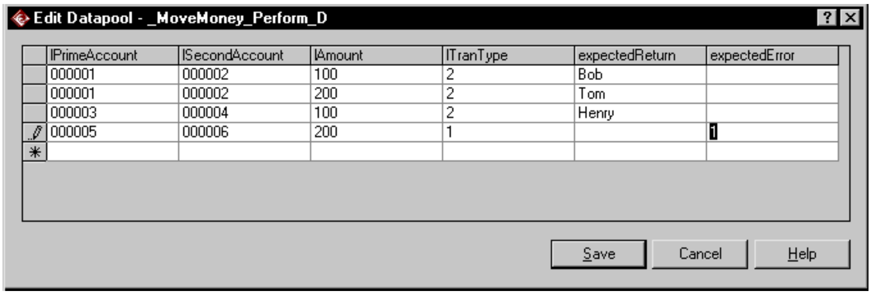
Name: _MoveMoney_Perform_D

Row: 1

Description: Autogenerated

QualityArchitect auto-generates a datapool, using the parameters in the `Perform` method (`IPrimeAccount`, `ISecondAccount`, `IAmount`, `ITranType`, `expectedReturn`, `expectedError`) for the column names. It names the datapool _MoveMoney_Perform_D.

2 Click **Edit Datapool Data** and populate the datapool with several rows.



IPrimeAccount	ISecondAccount	IAmount	ITranType	expectedReturn	expectedError
000001	000002	100	2	Bob	
000001	000002	200	2	Tom	
000003	000004	100	2	Henry	
000005	000006	200	1		1

For more information about datapools, see *Datapools* on page 20, the *Test Script Services for Visual Basic* manual, and the online Help for Rational TestManager.

Generating Stubs for the Unit Test

With QualityArchitect you can create stubs for any component called by the method-under-test.

When you generate stubs, QualityArchitect creates Visual Basic class files that you can copy into your Visual Basic project and use in place of actual components. Simply replace the actual component with the stub and recompile the project.

Because the `MoveMoney` method calls methods in the `Account` interface class, you can either generate a stub or run the tests directly against the actual `Account` class.

To generate the stubs:

1 Right-click the **Account** class in the Rose browser and click **Rational Test > Generate Stub**.

2 Select a directory for storing the stubs.

3 Click **OK**.

4 Make a copy of the `Account` class.

5 Replace the real `Account` class in the RQACOMSample application with the stubbed version.

6 Add a reference to “Rational QualityArchitect Playback Type Library” in the RQACOMSample project in Visual Basic.

7 Recompile RQACOMSample.

Note: Stubs must be deployed on the same computer as the test script.

For a high-level overview of stubs, see *Stubs* on page 16.

Creating Lookup Tables

After you generate the stubs, create a lookup table for each method in the stub called by the method-under-test. In this case, you need to create a look up table for the `Post` method.

Lookup tables are based on Rational datapool technology. Whereas a datapool is used to test inputs and expected behavior, a lookup table is used with stubs to simulate the behavior of an actual component.

To create a lookup table for the `Post` method in the `Account` class:

1 From the Rose browser, select the `Post` method in the `Account` bean.

2 Click **Tools > Rational Test > Stubs > Create look-up table**.

3 Populate the table with real data, for example:

lAccountNo	lAmount	Expected Return	Expected Error
Generated ID 1	*amount of Post*		
incorrect AccountNo			

At this point, you should be finished creating your tests assets.

Executing Test Scripts

To execute your text script in Visual Basic:

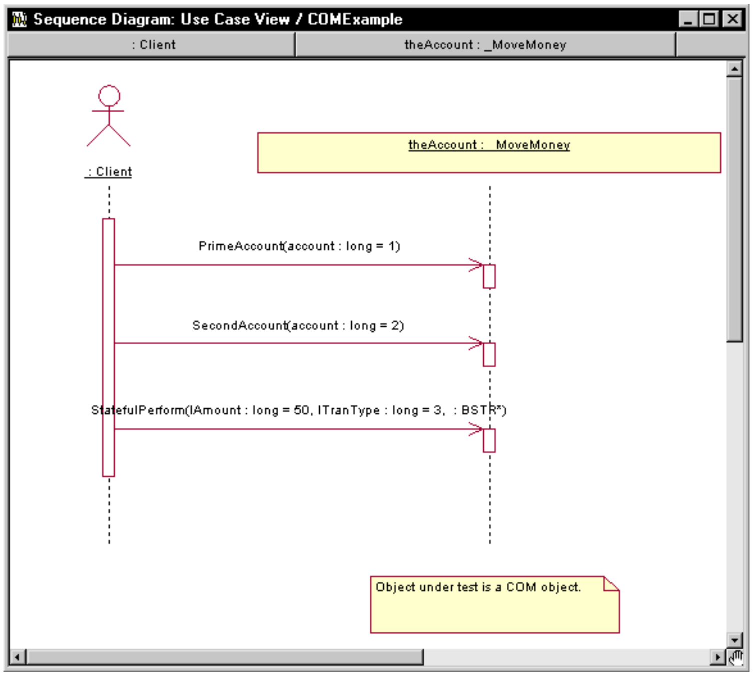
1 Open the Visual Basic project file.

2 Edit the test script (the .CLS file) as needed.

3 Click **Run > Start with Full Compile**.

Using COM Scenario Tests to Test Transactions

Scenario tests use Rose interaction diagrams to test transactions. To try out this feature, you can generate a scenario test for the COMExample sequence diagram that is included in the rqacomsample model.


Sequence Diagram: Use Case View / COMExample
: Client
theAccount : _MoveMoney
: Client
theAccount : _MoveMoney
PrimeAccount(account : long = 1)
SecondAccount(account : long = 2)
StatefulPerform(lAmount : long = 50, lTranType : long = 3, : BSTR*)

Object under test is a COM object.

When you generate a scenario test, QualityArchitect prompts you to insert a verification point for each message in your interaction diagram.

To generate a scenario test:

1 Open the COMExample sequence diagram in Rose.

2 Right-click in the diagram and click **Rational Test > Select Scenario Test Template.**

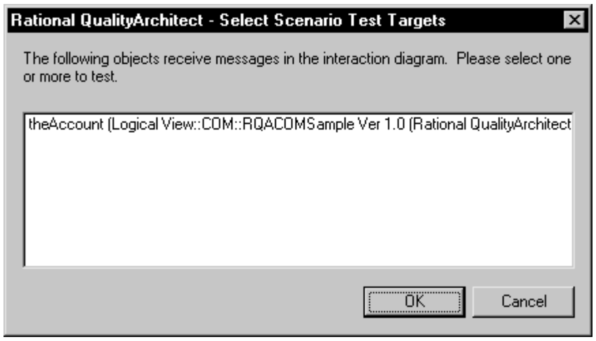
3 Verify that com_scenario_script_template appears in the File Name box and click **Open**.

   This template resides in the QualityArchitect\Templates\Scenario Test Templates\COM VB directory.

4 Right-click in the interaction diagram and click **Rational Test > Generate Scenario Test.**

5 In the Select Scenario Test Targets dialog box, select the scenario test targets, that is, the objects you want to test and click **OK**.

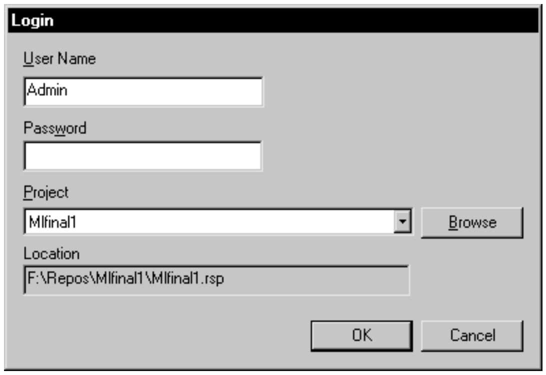
You can select one or more objects to test.


Rational QualityArchitect - Select Scenario Test Targets

The following objects receive messages in the interaction diagram. Please select one or more to test.

theAccount (Logical View::COM::RQACOMSample Ver 1.0 (Rational QualityArchitect

6 If prompted, log in to a project and click **OK**.


Login

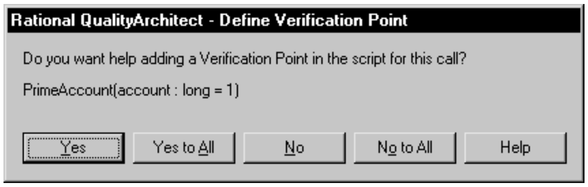
User Name: Admin

Password:

Project: Mlfinal1

Location: F:\Repos\Mlfinal1\Mlfinal1.rsp

7 In the Define Verification Points dialog box, click **Yes** to add a verification point for the first message in the diagram—`getBalance`.

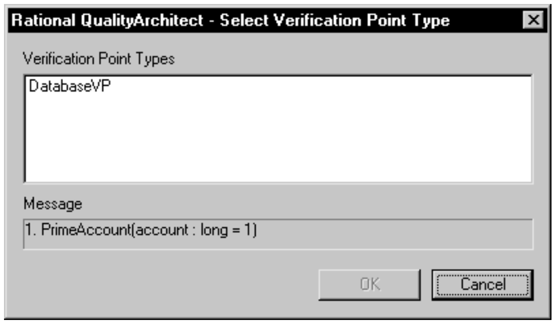

Rational QualityArchitect - Define Verification Point

Do you want help adding a Verification Point in the script for this call?

PrimeAccount(account : long = 1)

8 In the Select Verification Point Type dialog box, select a verification point type and click **OK**.

For this release, select the database verification point type—`DatabaseVP`.



DatabaseVP

1. PrimeAccount(account : long = 1)

9 At this point, the OLE DB Query Builder wizard starts. Use the Query Builder to connect to the database and to define a Select statement that can be used as a query. For more information about the Query Builder, see *Using the OLE DB Query Builder to Add Verification Points* on page 92.

10 Repeat Steps 8 and 9 for each message in the diagram.

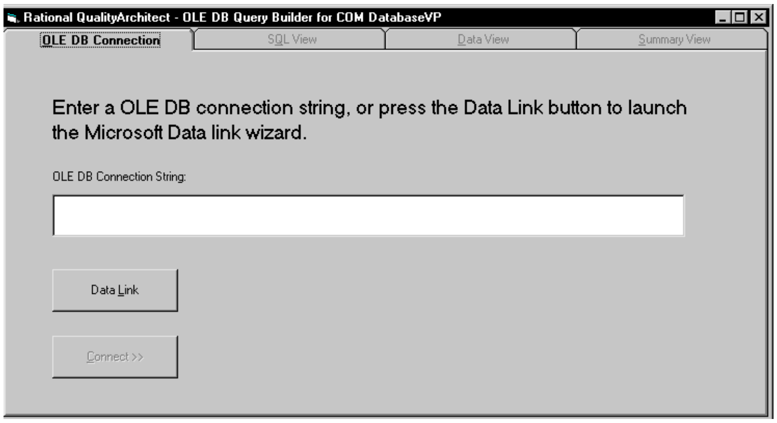
11 When you reach the last message, you are prompted to add a verification point at the end of the scenario. Click **Yes**.

12 Select a directory to store the tests in and click **OK**.

Note: You can also start the scenario test generator by right-clicking on a diagram in the Rose browser and then clicking **Rational Test > Generate Scenario Test**. However, when you generate code by right-clicking on a diagram name in the Rose browser, code generation always proceeds using the active diagram—the one that is open in a window—not necessarily the diagram that you clicked on.

Using the OLE DB Query Builder to Add Verification Points

The OLE DB Query Builder is a tool that helps you connect to and interact with databases for the purpose of defining database verification points.


Rational QualityArchitect - OLE DB Query Builder for COM DatabaseVP
OLE DB Connection
SQL View
Data View
Summary View
Data Link
Connect >>

Enter a OLE DB connection string, or press the Data Link button to launch the Microsoft Data link wizard.

OLE DB Connection String:

Connecting to the Database via OLE DB

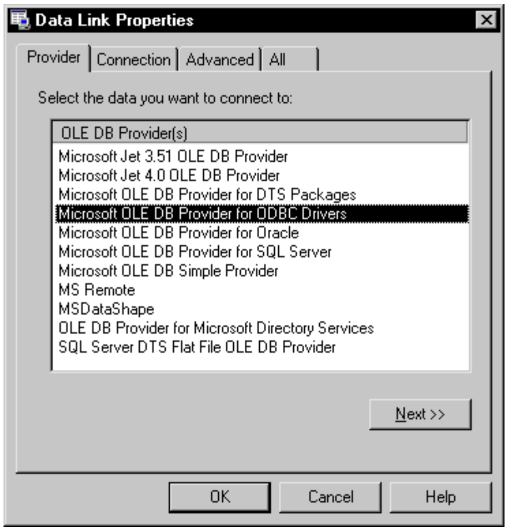
The first step involved in building a custom SQL query is entering an OLE DB connection string, which allows you to connect to a database.

When the OLE DB Query Builder starts, you can either type the connection string manually or click the **Data Link** button to display the Data Link Properties wizard, a graphical user interface that will assist you in building the connection string.

To use the Data Link Properties wizard:

1 Click the **Data Link** button to display the Provider page of the Data Link Properties wizard. (Click **Help** at any point to view online Help for the wizard.)

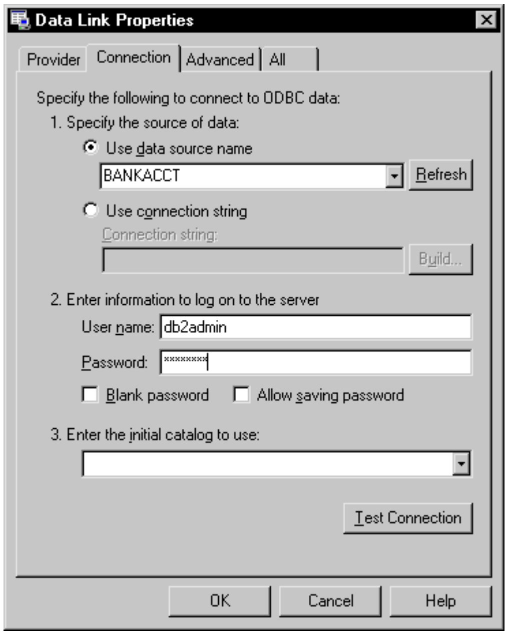
2 On the Provider page, select the appropriate OLE DB provider and click **Next**.



Select the data you want to connect to:

OLE DB Provider(s)
Microsoft Jet 3.51 OLE DB Provider
Microsoft Jet 4.0 OLE DB Provider
Microsoft OLE DB Provider for DTS Packages
Microsoft OLE DB Provider for ODBC Drivers
Microsoft OLE DB Provider for Oracle
Microsoft OLE DB Provider for SQL Server
Microsoft OLE DB Simple Provider
MS Remote
MSDataShape
OLE DB Provider for Microsoft Directory Services
SQL Server DTS Flat File OLE DB Provider

3 On the Connection page, select a data source name and enter a user name and password, if these are required to log in to the server.



Data Link Properties

Provider | Connection | Advanced | All

Specify the following to connect to ODBC data:

1. Specify the source of data:

[✓ Use data source name] BANKACCT

Use connection string

Connection string:

2. Enter information to log on to the server

User name: db2admin

Password: ********

Blank password / Allow saving password

3. Enter the initial catalog to use:

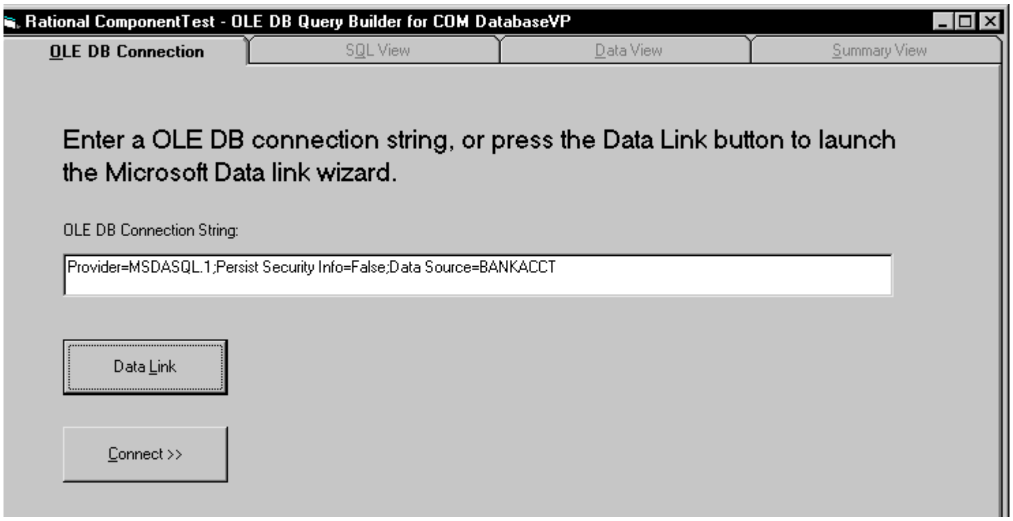
4 Also, on the Connection page, check **Allow Saving Password** to allow the password to be included in the connection string.

Note: If saved, the password is not encrypted.

5 Click **Test Connection**.

In most cases, it should not be necessary to change any of the default settings on the **Advanced** or **All** pages. Click the **Help** button for details.

6 Click **OK** to save the OLE DB Connection String and redisplay the Query Builder.



Enter a OLE DB connection string, or press the Data Link button to launch the Microsoft Data link wizard.

OLE DB Connection String:

```
Provider=MSDASQL.1;Persist Security Info=False;Data Source=BANKACCT
```

7 Click **Connect** to connect to the database.

Designing a Custom SQL Statement

After you connect to the database, you can design the custom SQL query statement that will be used to retrieve specific data from the database.

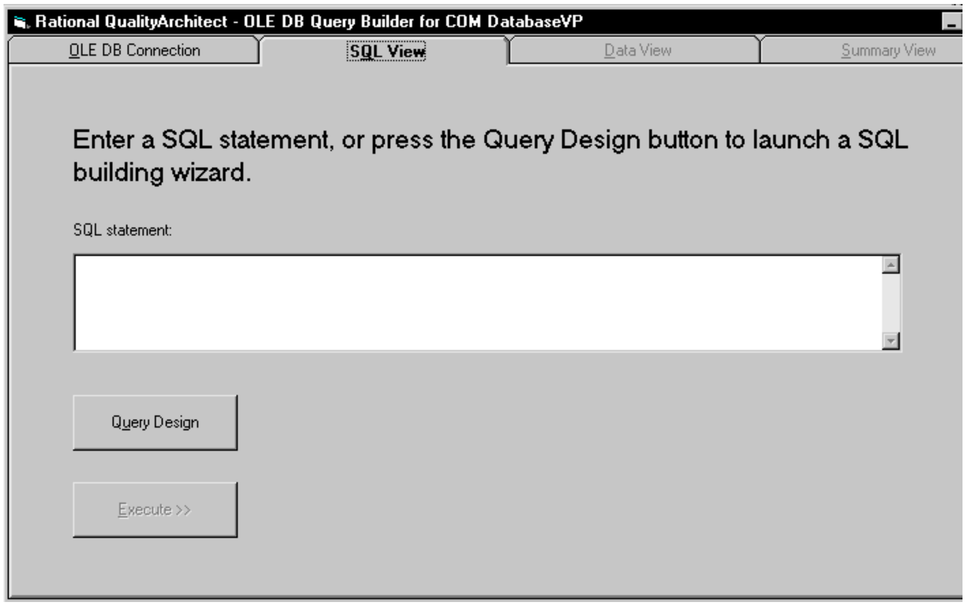
If you are familiar with SQL syntax and are familiar with the schema of the database you are connecting to, you can simply enter your custom SQL query statement in the SQL Text box.

Using the Query Design Wizard

Alternatively, you can use the Query Design wizard to interactively walk you through the design of your custom SQL query statement. The Query Design wizard helps you easily create complex SQL query statements by taking you step-by-step through the design process.

To use the Query Design wizard:

1 Click the **Query Design** button.

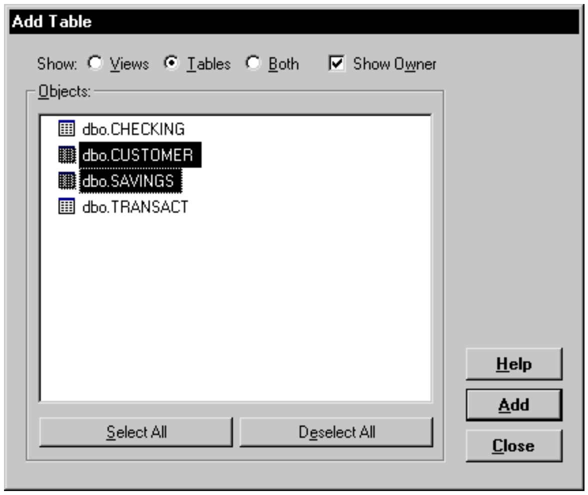


Rational QualityArchitect - OLE DB Query Builder for COM DatabaseVP

Enter a SQL statement, or press the Query Design button to launch a SQL building wizard.

SQL statement:

2 Select the tables you want to query and click **Add**.



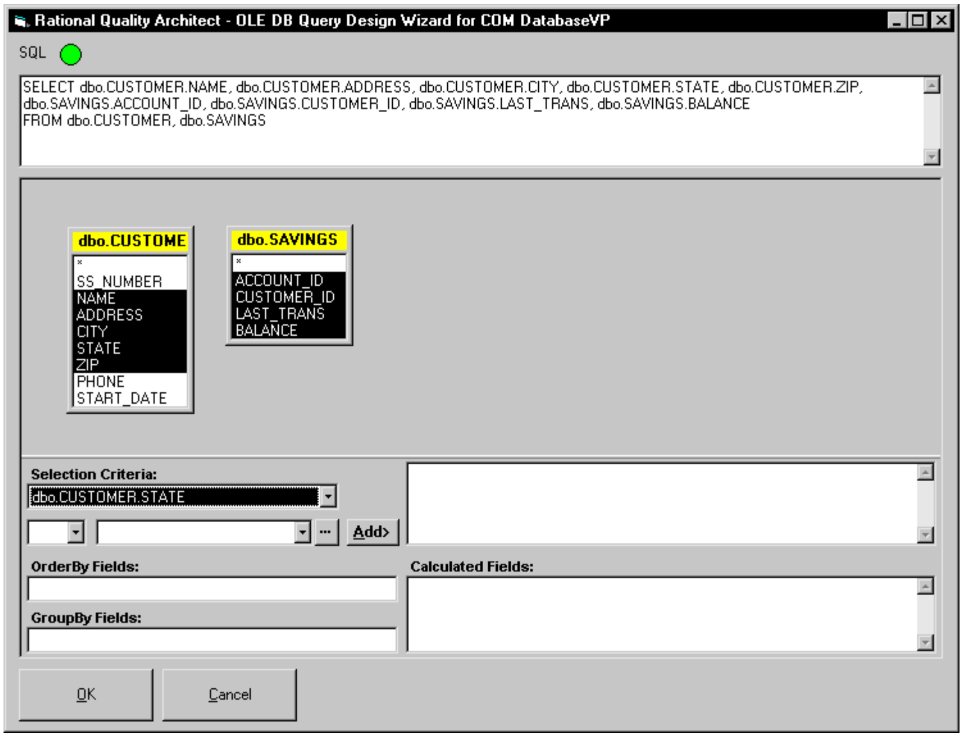
Add Table

Show: ○ Views ● Tables ○ Both ☑ Show Owner

Objects:

dbo.CHECKING
dbo.CUSTOMER
dbo.SAVINGS
dbo.TRANSACT

3 Select the columns to include in the result set.



```
SELECT dbo.CUSTOMER.NAME, dbo.CUSTOMER.ADDRESS, dbo.CUSTOMER.CITY, dbo.CUSTOMER.STATE, dbo.CUSTOMER.ZIP,
dbo.SAVINGS.ACCOUNT_ID, dbo.SAVINGS.CUSTOMER_ID, dbo.SAVINGS.LAST_TRANS, dbo.SAVINGS.BALANCE
FROM dbo.CUSTOMER, dbo.SAVINGS
```

Selection Criteria: dbo.CUSTOMER.STATE

Column names are listed in *TableName.ColumnName* format so that you can easily identify the columns in each table.

4 Enter selection criteria that will restrict the returned query results (optional).

5 Enter a sort order in the **OrderBy Fields** box (optional).

6 Enter a GroupBy order in the **GroupBy Fields** box (optional).

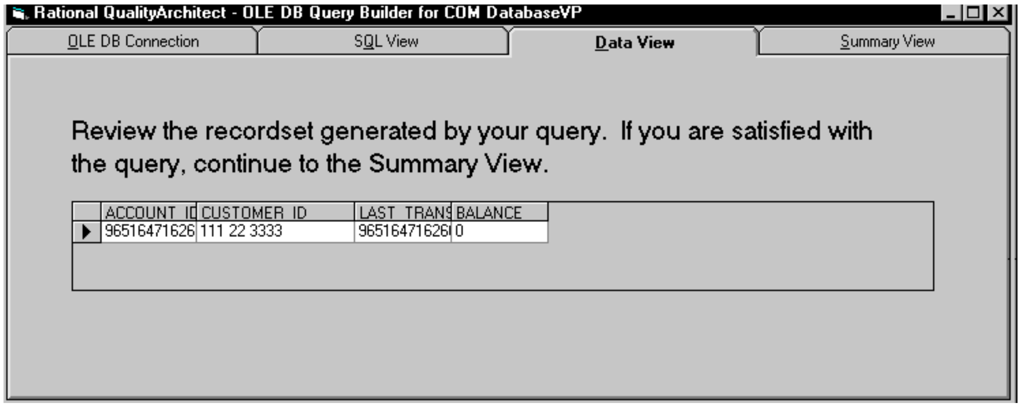
7 Enter any calculated fields.

8 Click **OK**.

9 Verify the SQL statement, make any edits as needed, and click **Execute.**

Reviewing the Record Set

The next step in building the query is to review the record set returned by the SQL statement. If you are satisfied with the results, click the **Summary View** tab. Otherwise, click the **SQL View** tab and redesign the query.



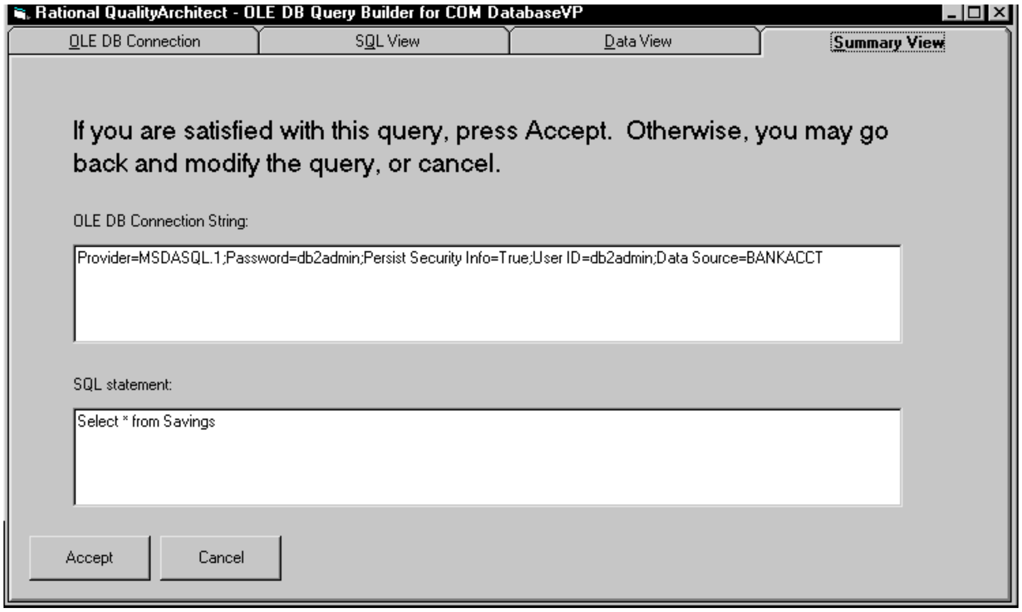
Rational QualityArchitect - OLE DB Query Builder for COM DatabaseVP

Review the recordset generated by your query. If you are satisfied with the query, continue to the Summary View.

ACCOUNT_ID	CUSTOMER_ID	LAST_TRANS	BALANCE
96516471626	111 22 3333	96516471626	0

Accepting the Query

The Summary View shows the OLE DB Connection String and the SQL statement that you have created. Click **Accept** to generate the query and complete the verification point.



Rational QualityArchitect - OLE DB Query Builder for COM DatabaseVP

If you are satisfied with this query, press Accept. Otherwise, you may go back and modify the query, or cancel.

OLE DB Connection String:

```
Provider=MSDASQL.1;Password=db2admin;Persist Security Info=True;User ID=db2admin;Data Source=BANKACCT
```

SQL statement:

```
Select * from Savings
```

Template Replacement Variables

A

This section describes the replacement variables that are used in the various templates used by Rational QualityArchitect. The code generators supplied with QualityArchitect replace the variables in the templates with real code and data derived from Rose model elements.

These replacement variables can be logically grouped into the following general categories:

- Replacement variables for unit test generation templates
- Replacement variables for scenario test generation templates
- Replacement variables for stub generation templates

Replacement Variables for Unit Test Generation Templates

The replacement variables for the unit test generation templates can be logically divided into the following categories:

- Variables used in all languages
- Variables used only in Visual Basic and COM
- Variables used only with Enterprise JavaBeans (EJBs)

For a list of the unit test generation templates, see *Templates* on page 7.

Variables Used in All Unit Test Generation Templates

The following replacement variables are used in all of the unit test generation templates:

Variable	Description and Example
<generation_date>	Shows when the script was generated. <generation_date> in the template becomes Date: 9/19/00 2:56:32 PM in the script.
<root_package>	Root directory location for all generated unit test scripts. The <root-package> is always `unittests`. <root_package> in the template becomes `unittests` in the script.
<package_name>	The package hierarchy in the Rose model, excluding the class and the top-level package name. For example, the Rose Item Fully Qualified Name := Logical View::COM::MyComponent::MyClass::MyOperationUnderTest" TestName := MyClassMyOperationUnderTest tms.StartTestServices "<root_package>\<package_name>\<test_name>" becomes unittests\COM\MyComponent\MyClassMyOperationUnderTest" in the script.
<operation_name>	The name of the operation selected for generation. Class=<operation_name>; TestNameScript.cls becomes Class=MyOperationUnderTest; TestNameScript in the script.
<class_name>	The name of the class selected for generation. Template: <class_name> Script: MyInterface
<test_name>	The name of the test script, calculated as follows: ClassNameOperationName QualityArchitect may modify <test_name> to conform to the target generation language. Example: ClassName := "_Account", OperationName := "Post", Language := "VB" Before: ExeName32="<test_name>.exe" After: ExeName32="AccountPost.exe" Note: In VB an object name cannot begin with "_" character, so the "_" is removed at generation time.

Variable	Description and Example
<datapool_name>	The name of the datapool, calculated as follows: ClassName_OperationName_CTD_DATAPOOL The DataStore understands that datapool names are limited to 40 characters, so it takes two parameters and tries to figure out the best name, such as "ClassNameOperationName", that fits within the 40 character limit. CTD_DATAPOOL causes "_D" to be appended to the end of the name and CTD_LOOKUPTABLE causes "_L" to be appended to the end of the name. Example: ClassName := "_Account", OperationName := "Post", Language := "VB" Before: dp.Open("<datapool_name>") After: dp.Open("_Account_Post_D")
<index>	Unique index, calculated as follows: ScriptSource\PackagePath\TestName CTD_SCRIPTTYPE_VB - Uses the "RQA VB Test Scripts" script source for the index calculation. CTD_SCRIPTTYPE_JAVA - Uses the "RQA Java Test Scripts" script source for the index calculation. Example: TestName := "AccountPost", PackagePath := "unittests\COM\MyComponent", ScriptType := CTD_SCRIPTTYPE_VB If no files exist with the name <ScriptSourceDirectory>\<PackagePath>\TestName Before: ExeName32="<test_name><index>.exe" After: ExeName32="AccountPost.exe" If <ScriptSourceDirectory>\<PackagePath>\AccountPost.vbp exists Before: ExeName32="<test_name><index>.exe" After: ExeName32="AccountPost1.exe"
<check_expected_result>	The code generated here depends on the target language for generation and the return value of the operation. If the operation return type is void, or in VB is marked as a "Sub", then the actual code that is inserted is: If (operation does NOT have a return value) Then <check_expected_result> := 'Log message indicating success. Else <check_expected_result> := 'If statement to compare the expected return with the actual return for equivalence. 'If equal, then log success, otherwise log error.

Variable	Description and Example
<method_declaration>	The code that is generated here depends on the target language for generation and the operation that is selected. The result is a string that can be used to declare a method. Mo newline characters are added to this variable.
<paramter_declarations>	The code that is generated here depends on the target language for generation and the operation that is selected. The result is a string that can be used to declare all of the variables that will be used as arguments to the operation that has been selected for generation. Newline characters are added to this string so that each variable is declared on a new line.
<paramter_initialization>	The code that is generated here depends on the target language for generation and the operation that is selected. The result is a string that can be used to initialize all of the variables that are declared in <parameter_declarations> to be values from a datapool. Each parameter type is checked to see if it can be driven using a datapool value. If not, a comment is inserted in place of the datapool assignment.
<return_val>	The code that is generated here depends on the target language for generation and the operation that is selected. The result is an empty string if the operation does NOT return a value, or "actRet = " if it does.
<operation_arglist>	The code that is generated here depends on the target language for generation and the operation that is selected. The result is a string that can be used in the function invocations string. Example TestClass::TestShort(ByVal Arg1 As Integer, ByRef Arg2 As Integer) As Integer Before: Dim tc As TestClass Dim actRet As Integer <parameter_declarations> ‘ Invoke: <method_declaration> of TestClass <return_value> tc.<operation_name> (<operation_arglist>) After: Dim tc As TestClass Dim actRet As Integer Dim arg1 As Integer Dim arg2 As Integer ‘ Invoke: TestShort(ByVal Arg1 As Integer, ByRef Arg2 As Integer) As Integer of TestClass actRet = tc.TestShort (arg1,arg2)

Variables Used Only with the COM/Visual Basic Templates

The following replacement variables are used only with the COM/VB unit test generation templates:

Variable	Description and Example
<interface_name>	Interface name of the operation selected for generation. Example: Rose Item Fully Qualified Name := “Logical View::COM::MyComponent::_MyInterface::MyOperationUnderTest" Before: <Interface_name> After: _MyInteface Note: Same as <class_name> for VB scripts generated from COM interfaces.
<library_name>	Library name that contains the class that is implementing this operation, calculated as: Dim rsModule As RoseModule rsModule = cls.GetAssigendModules(1) Dim rsProp As RoseProperty rsProp = rsModule.FindProperty("COM","library") <library_name> = rsProp.Value Example: Rose Item Fully Qualified Name := “Component View::COM::MyComponent" Before: Set obj = CreateObject("<library_name>.Foo") After: Set obj = CreateObject("MyComponent.Foo")
<coclass_name>	CoClass that implements the interface that the operation belongs to. If more than one coclass implements the interface, the first one is chosen. Example: Rose Operation := "Logical View::COM::MyComponent::_Account::Post" Rose Interface := "Logical View::COM::MyComponent::_Account" Rose CoClass := "Logical View::COM::MyComponent::Account" Before: Set obj = CreateObject("MyComponent.<coclass_name>") After: Set obj = CreateObject("MyComponent.Account")

Variables Used Only with the EJB Templates

The following replacement variables are used only with the EJB unit test generation templates:

Variable	Description and Example
<remote_interface_name>	Name of the EJB Remote Interface Rose Item Fully Qualified Name := Logical View::RationalBankAcct::Checking::getBalance Before: Object o = initContext.lookup("<remote_interface_name>"); After: Object o = initContext.lookup("Checking");

<createparam_declaration>	String that declares all of the parameters for the EJB Home Interface Create method that is associated with the operation's class selected for generation.
	
	Example:
	Before:
	// Declare arguments to the create method
	<createparam_declaration>
	After:
	// Declare arguments to the create method
	long accountID = 0;
	String customerID = null;
	long lastTrans = 0;
	java.math.BigDecimal openBalance = null;

<createparam_init>	String that will initialize all of the create parameters for the EJB Home Interface Create method using a datapool initialization.
	
	Before:
	// Declare arguments to the create method
	<createparam_declaration>
	
	After:
	Initialize arguments for the create method
	AccountID = dp.value("accountID").longValue();
	customerID = dp.value("customerID").toString();
	lastTrans = dp.value("lastTrans").longValue();
	openBalance = dp.value("openBalance").getBigDecimal();

Variable	**Description and Example**
<create_params>	String that can be used as an arglist for the create method invocation. Before: Invoke the create method. <remote_interface_name> remote = home.create(<create_params>); After: Invoke the create method. Checking remote = home.create(accountID, customerID, lastTrans, openBalance);
<keyvalue_declaration>	Same as <createparam_declaration> but for the Key class constructor method that is associated with the operation class selected for generation.
<keyvalue_init>	Same as for the <createparam_init> but for the key class constructor's parameters.
<key_params>	Same as for the <create_params> but for the key class constructor's parameters.
<datapool_init>	Same as the <parameter_initialization> that is indicated above for COM/VB. This is provided only for EJB and NOT for COM, whereas <parameter_initialization> is provided for both.

Replacement Variables for Scenario Test Generation Templates

The replacement variables for the scenario test generation templates can be logically divided into the following categories:

- Variables used in both the COM/VB and EJB templates
- Variables used only in the COM/VB templates
- Variables used only in the EJB templates

For a list of the scenario test generation templates, see *Templates for Scenario Test Generation* on page 11.

Variables Used in Both the COM/VB and EJB Templates

The following replacement variables are used in both COM/VB and EJB templates for scenario test generation:

Variable	Description	Template
<DIAGRAM_NAME>	Rose diagram name	Com_scenario_project Com_scenario_basmain Com_scenario_script Weblogic_scenario Websphere_scenario
<QUALIFIED_DIAGRAM_NAME>	Fully-qualified diagram name including the package hierarchy containing the diagram. Example: Use Case View::MyPackage::MyDiagram The template processor typically removes embedded blanks and changes the double-colons to either backslashes, "\", or periods, ".", depending on the usage (Java package or file path).	Com_scenario_basmain Com_scenario_script Weblogic_scenario Websphere_scenario
<AUTHOR_NAME>	Login ID supplied when you connect to a test datastore project.	Com_scenario_basmain Com_scenario_script Weblogic_scenario Websphere_scenario
<GENERATION_DATE>	System time	Com_scenario_basmain Com_scenario_script Weblogic_scenario Websphere_scenario
<DATAPOOL_NAME>	System assigned name of a datapool for the diagram.	Com_scenario_script Weblogic_scenario Websphere_scenario
<VARIABLE_INITIALIZATIONS>	Generated code for initializing script program variables used in datapools and as parameters in operations.	Com_scenario_script Weblogic_scenario Websphere_scenario
<OPERATIONS>	Generated code to call all of the operations implied by the user's selection of test targets.	Com_scenario_script Weblogic_scenario Websphere_scenario

Variable	Description	Template
<RETURN_VARIABLE>	If the operation returns a value then this is a variable name generated by concatenating "retval_" with the Operation Name. May or may not be present in generated code.	Com_scenario_operation Scenario_java_method1
<CLASS_NAME>	Name of the Rose interface class.	Com_scenario_constructor Com_scenario_operation Scenario_java_method1 Scenario_java_method2 Weblogic_scenario_constructor Websphere_scenario_constructor
<VERIFICATION>	Generated code for handing a verification point inserted at the user's option by the code generator.	Com_scenario_operation Com_scenario_script Scenario_java_method1 Scenario_java_method2 Weblogic_scenario Websphere_scenario
<DIAGRAM_NAME>	Rose diagram name	Com_scenario_project Com_scenario_basmain Com_scenario_script Weblogic_scenario Websphere_scenario
<QUALIFIED_DIAGRAM_NAME>	Fully-qualified diagram name including the package hierarchy containing the diagram. Example: Use Case View::MyPackage::MyDiagram The template processor typically removes embedded blanks and changes the double-colons to either backslashes, "\", or periods, ".", depending on the usage (Java package or file path).	Com_scenario_basmain Com_scenario_script Weblogic_scenario Websphere_scenario

Variables Used Only in the COM/VB Scenario Test Templates

The following replacement variables are used only in the COM/VB templates for scenario test generation:

Variable	Description	Templates Used In
<VARIABLE_DECLARATIONS>	Generated code for declaring script program variables used in datapools and as parameters in operations.	Com_scenario_script
<MODEL_NAME>	The name of the model with the file path and file extension removed. E.g., Given "C:\TEMP\mymodel.mdl", the <MODEL_NAME> is "mymodel".	Com_scenario_basmain
<OPERATION_NAME>	Name of an operation. This corresponds to the Rose operation name.	Com_scenario_operation
<OPERATION_ARGLIST>	The argument list for an operation. Derived from the Rose parameters collection associated with an operation.	Com_scenario_operation
<COCLASS_NAME>	Name of the coclass implementing the Interface object referenced in the diagram.	Com_scenario_constructor
<LIBRARY_NAME>	Name of the COM Library associated with the Rose Interface Class associated with the operation.	Com_scenario_constructor
<INDEX>	If used, this is a monotonically increasing integer used to uniquely identify instances of like-named things. Typically not used in code generated for secenarios.	Com_scenario_basmain
<SCRIPT_DIRECTORY>	The directory path where this script lives, relative to directory "root" where RQA scripts are stored. Example: \scenariotests\ratlbankacct\usecasevie w	Com_scenario_script

Variables Used Only in the EJB Scenario Test Templates

The following replacement variables are used only in the EJB templates for scenario test generation:

Variable	Description	Templates Used In
<OPERATION_SIGNATURE>	In Java/EJB this is the entire signature of an operation call including the concatenation of the operation name and its argument list.	Scenario_java_method1 Scenario_java_method2

Replacement Variables for Stub Generation Templates

The replacement variables for the stub generation templates can be logically divided into the following categories:

- Variables used only in Visual Basic and COM
- Variables used only with Enterprise JavaBeans (EJBs)

For a list of the stub generation templates, see *Templates for Stub Generation* on page 19.

Replacement Variables for the COM/VB Stub Templates

The following replacement variables are used in the COM/VB templates for stub generation:

Variable	Description	Template
<<!VBClassName!>>	Class name for the stub. Example: Account	VBCOMClass FunctionBody PropertyGetBody PropertyLetBody SubBody.template
<<!MethodBodyTemplate!>>	Causes the stub generator to use one of the seven method body templates to generate the declaration and definition for each public method in the stub. See *Templates for Stub Generation* on page 19 for more information.	VBCOMClass

Variable	Description	Template
<<!MethodName!>>	Name of the method. Example: Post	FunctionBody FunctionBodyWithoutLookUp PropertyGetBody PropertyGetBodyWithoutLookUp PropertyLetBody SubBody SubBodyWithoutLookUp
<<!ParameterDeclarations!>>	Comma separated list of parameter types and names to be included as part of the method declaration. Example: ByVal lAccountNo As Long, ByVal lAmount As Long	FunctionBody PropertyGetBody PropertyLetBody SubBody
<<!ReturnType!>>	Return type for the method. Example: String	FunctionBody FunctionBodyWithoutLookUp PropertyGetBody PropertyGetBodyWithoutLookUp
<<!ParameterNamesAsStrings!>>	Comma separated list of parameter names as strings. Example: "lAccountNo", "lAmount"	FunctionBody PropertyGetBody PropertyLetBody SubBody
<<!ParameterNames!>>	Commna separated list of parameter names. Example: lAccountNo, lAmount	FunctionBody PropertyGetBody PropertyLetBody SubBody
<<!ParameterValuesAsStrings!>>	Comma separated list of parameter values converted to strings. Example: "CStr(lAccountNo), CStr(lAmount)" NOTE: For complex data types such as arrays, the generated code will need to be modified to compile and work.	FunctionBody PropertyGetBody PropertyLetBody SubBody
<<!LookUpTableName!>>	Name of the lookup table to be used for the method. Example: _Account_Post_L	FunctionBody PropertyGetBody PropertyLetBody SubBody

Variable	Description	Template
<<!ParameterValuesAsSumofStrings!>>	Parameter values converted to String and concatenated. NOTE: For complex data types such as arrays, the generated code will need to be modified to compile and work. Example: CStr(lAccountNo) + ", " + CStr(lAmount)	FunctionBody PropertyGetBody PropertyLetBody SubBody
<<!ReasonForNoLookupCodeGeneratio n!>>	Describes why lookup code was not generated. Example: This Method does not have parameters. Lookup code cannot be generated. Insert code here to add logic.	FunctionBodyWith outLookUp PropertyGetBodyW ithoutLookUp SubBodyWithoutLo okUp

Replacement Variables for the EJB Stub Templates

The following replacement variables are used in the EJB templates for stub generation:

Variable	Description	Template
<<!JavaPackage!>>	Package name of the EJB. Example: RationalBankAcct	Session_Home Session_Remote Session_Bean
<<!HomeInterfaceName!>>	Class name for the home interface. Example: ManageAccountsHome	Session_Home
<<!HomeMethods!>>	Method declarations for methods in the home interface. For example, RationalBankAcct.ManageAccounts create() throws javax.ejb.CreateException,java.rmi.Re moteException.	Session_Home
<<!RemoteInterfaceName!>>	Class name for the remote interface. Example: ManageAccounts	Session_Remote MethodBody MethodBodyWithoutExce ptions MethodBodyWithoutRetu rnValue.

Variable	Description	Template

<<!RemoteMethods!>>	Method declarations for methods in the remote interface.
	Example:
	void deleteAllCheckingAccts() throws java.rmi.RemoteException;
	void deleteAllSavingsAccts() throws java.rmi.RemoteException;
	...
	java.math.BigDecimal withdrawFromChecking(long accountID, java.math.BigDecimal amount) throws java.rmi.RemoteException,javax.naming.NamingException,javax.ejb.EJBException;
	java.math.BigDecimal withdrawFromSavings(long accountID, java.math.BigDecimal amount) throws java.rmi.RemoteException,javax.naming.NamingException,javax.ejb.EJBException;
		Session_Remote

<<!ImplementationClassName!>>	Class name of the EJB implementation class. Example: ManageAccountsBean	Session_Bean
<<!MethodBodyTemplate!>>	This variable causes the stub generator to use one of the four methodbody templates to generate the declaration and definition for each public method in the implementation class. The method body templates are chosen via the following criteria: MethodBodyWithoutLookUp.—Used when lookup code cannot be generated either because the method has no parameters, or method has neither return value nor exceptions, or one of the parameters are complex and lookup code cannot be generated automatically. MethodBodyWithoutExceptions—Used when method does not throw exceptions. MethodBodyWithoutReturnValue—Used when method does not have a return value (e.g. returns void). MethodBody—Used for all other methods.	Session_Bean

Variable	Description	Template
<<!ReturnType!>>	Return type for the method Example: java.math.BigDecimal	MethodBody MethodBodyWithoutExceptions MethodBodyWithoutLookUp
<<!MethodName!>>	The Method Name Example: depositToChecking	MethodBody MethodBodyWithoutExceptions MethodBodyWithoutLookUp MethodBodyWithoutReturnValue
<<!ParameterDeclarations!>>	Comma separated list of parameter types and names to be included as part of the method declaration. Example: long accountID, java.math.BigDecimal amount	MethodBody MethodBodyWithoutExceptions MethodBodyWithoutLookUp MethodBodyWithoutReturnValue
<<!Exceptions!>>	Comma separated list of exceptions that the method throws to be included as part of the method declaration. Includes the word "throws". Example: throws java.rmi.RemoteException,javax.naming.NamingException,javax.ejb.EJBException	MethodBody MethodBodyWithoutLookUp MethodBodyWithoutReturnValue
<<!ParameterCount!>>	Number of parameter for the method Example: 3	MethodBody MethodBodyWithoutExceptions MethodBodyWithoutReturnValue

<<!ParameterNamesAsStringArray!>>	Code to turn parameter names into array of strings.
	Example:
	ParamNames[0] = "accountID";
	ParamNames[1] = "amount";
		MethodBody
		MethodBodyWithoutExceptions
		MethodBodyWithoutReturnValue

<<!Return!>>	The word "Return" + a space Example: Return	MethodBody MethodBodyWithoutExceptions MethodBodyWithoutLookUp

Variable	Description	Template
<<!ParameterNames!>>	Comma separated list of parameter names, for example accountID, amount	MethodBody MethodBodyWithoutExceptions MethodBodyWithoutReturnValue
<<!InitialReturnValue!>>	Initial value assigned to the return value, for example null. Zero for numeric types false for boolean null for String and Objects	MethodBody MethodBodyWithoutExceptions MethodBodyWithoutLookUp
<<!LookUpTableName!>>	Name of the lookup table to be used for the method, for example ManageAccountsBean_depositToChecking_L	MethodBody MethodBodyWithoutExceptions MethodBodyWithoutReturnValue

<<!ParameterValuesAsStringArray!>>	Code to turn parameter values into array of strings.
	For example:
	values[0] = Long.toString(accountID);
	values[1] = amount.toString();
		MethodBody MethodBodyWithoutExceptions MethodBodyWithoutReturnValue

<<!ParameterValuesAsSumofStrings!>>	Parameter values are converted to sum of strings. Example: values[0] + " " + values[1] + " "	MethodBody MethodBodyWithoutExceptions MethodBodyWithoutReturnValue
<<!ConvertStringValueToReturnType!>>	Converts the exptected return value read from the lookup table to the return value type. Example: retval = new java.math.BigDecimal(sRetval);	MethodBody MethodBodyWithoutExceptions

Variable	Description	Template

<<!CatchBlocks!>>	Catch block for exception that the method throws. It is used to throw the exception that lookup table instructs.
	Example:
	catch (java.rmi.RemoteException e)
	{
	throw e;
	}
	catch (javax.naming.NamingException e)
	{
	throw e;
	}
		MethodBody MethodBodyWithoutReturnValue

<<!ReasonForNoLookupCodeGeneration!>>	Describes why lookup code was not generated.
	For example:
	//This Method does not have parameters. Lookup code cannot be generated.
	//Insert code here to add logic.
		MethodBodyWithoutLookUp

Troubleshooting B

This section provides troubleshooting techniques you can use when running Rational QualityArchitect.

Resource File Not Found

Symptom

The following message appears when you open a Visual Basic project after generating a script

`File not found:` *FileName*`.Res`

Explanation

During script generation, QualityArchitect compiles the resources for datapool configuration using the Microsoft Visual Studio resource compiler—rc.exe. The end result is a resource file—*test*.res. For this to work correctly, you must do one of the following:

- Add the file rc.exe to the User or System path, if it's not already there. By default, rc.exe is installed in two places:
  - *<Visual Studio Directory>*\Common\MSDev98\Bin
  - *<Visual Studio Directory>*\VB98\Wizards
- As an alternative, you can edit the file compile_resource.bat in the QualityArchitect directory and specify the full path to rc.exe on the command line in that file.

  To do this, make the following change:

  Before: `"RC.EXE" -v %1 > "%~dpn1.log"`

  After: `“<Visual Studio Directory>\VB98\Wizards\ RC.EXE” -v %1 > "%~dpn1.log"`

If you do neither of the above, you will see the File Not Found message when you open the Visual Basic project after generating a script.

Any messages generated by the compilation of the resource file are written to the <*script name*>.log file, which is saved in the same directory as the script.

Glossary

application-under-test. The software being tested. See also system-under-test.

baseline results. A persistent snapshot of data that is assumed to be correct and is used as the expected data object in a static verification point.

bean class. Class that actually implements the bean's business methods.

black-box testing. Tests that rely on a requirements definition or functional description of the application-under-test. A record and playback tool, such as Robot, is an example of a black-box testing tool.

class invariant. A set of rules that hold true when an object is in a stable state. The class invariant consists of a list of requirements on the data in a class. See also Design by Contract, precondition, and postcondition.

collaboration diagram. An interaction diagram that shows the sequence of messages that implement an operation or a transaction. Collaboration diagrams and sequence diagrams are alternate representations of an interaction. Collaboration diagrams show objects, their links, and their messages. They can also contain simple class instances and class utility instances. Each collaboration diagram provides a view of the interactions or structural relationships that occur between objects and object-like entities in the current model.

container-managed persistence. With container-managed persistence, the container is responsible for synchronizing the fields in an entity bean with data in a database.

context factory. A Java object that contains the JNDI information required by a naming service.

data-driven testing. A type of software testing that tests code with specific input and output values. Data-driven tests are often used to compare expected and actual output values. See also functional testing.

database verification point. A type of verification point used with Rational QualityArchitect. The database verification point tests the results of a SQL statement.

datapool. A source of test data that test scripts can draw from during playback. You can generate datapools using the Datapool Manager, or you can derive datapools from other sources such as your database.

Design By Contract. A programming methodology based on three important concepts: preconditions, postconditions, and a class invariant.

entity bean. An object representation of persistent data that is maintained in a permanent data store, such as a database. A primary key identifies each instance of an entity bean. Entity beans typically model business concepts that can be expressed as nouns, such as a customer or a bank account. Entity beans are transactional, and they are recoverable following a system crash.

functional test. A test to determine whether a system, application, or component functions as intended. Functional tests often compare how the application-under-test behaves in the current build against its behavior in previous builds.

Grid Comparator. The Rational Test component for reviewing, analyzing, and editing data files for text and numeric verification points in grid formats. The Grid Comparator displays the differences between the recorded baseline data and the actual data captured during playback.

home interface. An interface class for an enterprise bean that defines life-cycle methods for the bean, that is, methods for creating, removing, and finding beans.

IDE. Integrated Development Environment. This environment consists of a set of integrated tools that are used to develop a software application. Examples of IDEs supported by Rational QualityArchitect include Visual Age and Visual Cafe.

interaction diagram. See collaboration diagram and sequence diagram.

log. A file that contains the record of events that occur while playing back a script.

LogViewer. See Rational LogViewer.

playback. The process of executing a script.

postcondition. A requirement that a method, routine, or function has on its result. The requirement is checked after the method executes.

precondition. A requirement that a method, routine, or function has on the values supplied to its parameters. The requirement is checked before the method executes.

Rational Administrator. The Rational Test component that you use to create and maintain repositories, projects, users, groups, computers, and SQL Anywhere servers.

Rational LogViewer. The Rational Test component for displaying log files, which contain the record of events that occur while playing back a script or running a schedule. Also, the component from which you start the four Comparators.

Rational Repository. The Rational Test component for storing information about test planning and test execution. All Rational Test components on your computer update and retrieve data from the same active repository. A Rational Repository can use either a Microsoft Access database or a Sybase SQL Anywhere database.

Rational TestManager. The Rational Test product for managing the overall testing effort. You use it to define and store information about test documents, requirements, scripts, schedules, and sessions.

receiver object. The object that receives the messages in a Rose interaction diagram.

regression testing. Testing that occurs over successive builds of an application.

remote interface. An interface class for an enterprise bean that defines all of the bean's business methods.

requirements-based testing. A testing strategy based on test requirements. Requirements-based testing measures the number of test requirements that have been verified compared to all that have been identified.

Repository. See Rational Repository.

script. See test script.

sequence diagram. A graphical view of a scenario that shows object interaction in a time-based sequence, that is, what happens first, what happens next. Sequence diagrams establish the roles of objects and help provide essential information to determine class responsibilities and interfaces. This type of diagram is best used during early analysis phases in design because they are simple and easy to comprehend. Sequence diagrams are normally associated with use cases. Sequence diagrams are closely related to collaboration diagrams and both are alternate representations of an interaction. There are two main differences between sequence and collaboration diagrams: sequence diagrams show time-based object interaction while collaboration diagrams show how objects associate with each other.

session bean. A session bean typically models business concepts that can be expressed as a verb, such as managing an account or executing a transaction. A session bean is created by a client and in most cases exists only for the duration of a single client/server session. Session beans can be transactional, but (normally) they are not recoverable following a system crash. Session beans can be stateless or stateful.

stub. The minimum set of interfaces for a component that interacts with the component-under-test. Stubs can be used to control the results returned from components that are dependent on the component-under-test.

test case. A set of test inputs, execution conditions, and expected results developed for a particular objective, such as to exercise a particular program path or to verify compliance with a specific requirement.

test script. Test scripts are the computer-readable instructions that automate the execution of a test procedure. Test scripts may be generated automatically using test automation tools, programmed using a programming language, or a combination of recording, generating, and programming. With Rational test generation tools, the test script also includes a repository object. EJB test scripts, in particular, are generated in Java, and all generated Java test scripts extend the TestScript class.

test log. See log.

TestManager. See Rational TestManager.

verification point. A functional testing construct used by a test script to verify a specific behavior of the application or component-under-test. Static verification points capture information about the application-under-test and store it as the baseline. During playback, a verification point recaptures the object information and compares it to the baseline. Results of the verification point are maintained in a log, allowing for analysis of overall functional correctness and test case coverage.

white-box testing. Tests that rely on knowledge of the code, specifications, or other source material to perform the test. White-box testing is also called Structural testing. Rational QualityArchitect is an example of white-box testing tool.

Index