OpenEdge Development: Progress Dynamics Advanced Development

John Sadd

Expert Series
Acknowledgements

Much of the material in this book is derived from functional specifications for the various product areas it covers, and from white papers written by product developers. Many developers created that original material, without which this book would not have been possible. They include Anthony Swindells, Peter Judge, Mark Davies, Neil Bell, Chris Koster, Bruce Gruenbaum, Don Bulua, and Haavard Danielsen. Frank Beusenberg of Progress EMEA created the original code for the Browser pop-up example used in the chapter on Using the Dynamics Managers. Linda Gray provided invaluable editing assistance for the material. Ellen Marie Loycano, Linda Miller, and Ray Phillips assisted with the book’s final production.
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preface</strong></td>
<td>Preface–1</td>
</tr>
<tr>
<td>1. Writing Super Procedures for Objects</td>
<td>1–1</td>
</tr>
<tr>
<td>- Client-side code</td>
<td>1–3</td>
</tr>
<tr>
<td>- Client-side code in a distributed application</td>
<td>1–3</td>
</tr>
<tr>
<td>- Using super procedures for client code</td>
<td>1–4</td>
</tr>
<tr>
<td>- Using custom super procedures in Progress Dynamics</td>
<td>1–5</td>
</tr>
<tr>
<td>- Defining a custom super procedure for an object</td>
<td>1–6</td>
</tr>
<tr>
<td>- Writing code for a custom super procedure</td>
<td>1–8</td>
</tr>
<tr>
<td>- Defining logic in a single custom super procedure</td>
<td>1–9</td>
</tr>
<tr>
<td>- Creating a new super procedure</td>
<td>1–11</td>
</tr>
<tr>
<td>- Defining user interface events in Progress Dynamics</td>
<td>1–11</td>
</tr>
<tr>
<td>- Modifying the Object Generator defaults for a dynamic object</td>
<td>1–12</td>
</tr>
<tr>
<td>- Defining UI events for the viewer</td>
<td>1–14</td>
</tr>
<tr>
<td>- Naming conventions for UI events and custom super procedures</td>
<td>1–17</td>
</tr>
<tr>
<td>- Writing the supporting procedures for the UI event</td>
<td>1–17</td>
</tr>
<tr>
<td>- Testing the dynamic viewer with the UI event</td>
<td>1–18</td>
</tr>
<tr>
<td>- Moving client logic support to an extended class</td>
<td>1–18</td>
</tr>
<tr>
<td>- Running a PLIP from client logic</td>
<td>1–28</td>
</tr>
<tr>
<td>- Using launch.i or dynlaunch.i to run the PLIP</td>
<td>1–33</td>
</tr>
<tr>
<td>- Testing the completed business logic procedure</td>
<td>1–35</td>
</tr>
<tr>
<td>- Building a custom super procedure for a browser</td>
<td>1–37</td>
</tr>
<tr>
<td>- Useful browser properties</td>
<td>1–38</td>
</tr>
<tr>
<td>- Coding the rowDisplay procedure</td>
<td>1–39</td>
</tr>
<tr>
<td>- Creating the other support functions</td>
<td>1–39</td>
</tr>
<tr>
<td>- Defining the custom super procedure for a browser</td>
<td>1–40</td>
</tr>
<tr>
<td>- Changing browser attributes for the master and instance</td>
<td>1–41</td>
</tr>
<tr>
<td>- Using the client logic API</td>
<td>1–41</td>
</tr>
<tr>
<td>- Basic rules</td>
<td>1–42</td>
</tr>
<tr>
<td>- Logic</td>
<td>1–42</td>
</tr>
<tr>
<td>- Object qualification</td>
<td>1–43</td>
</tr>
<tr>
<td>- Client logic functions</td>
<td>1–46</td>
</tr>
<tr>
<td>- Organizing logic at the level of procedures or functions</td>
<td>1–50</td>
</tr>
</tbody>
</table>
### 2. Customizing Classes

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview</td>
<td>2–2</td>
</tr>
<tr>
<td>Progress Dynamics class hierarchy</td>
<td>2–2</td>
</tr>
<tr>
<td>Types of class customizations</td>
<td>2–3</td>
</tr>
<tr>
<td>Definitions</td>
<td>2–4</td>
</tr>
<tr>
<td>Defining attributes and default values</td>
<td>2–5</td>
</tr>
<tr>
<td>Adding an attribute to the Repository</td>
<td>2–5</td>
</tr>
<tr>
<td>Static ADM attribute support</td>
<td>2–5</td>
</tr>
<tr>
<td>Special attributes</td>
<td>2–6</td>
</tr>
<tr>
<td>Customizing object classes</td>
<td>2–7</td>
</tr>
<tr>
<td>Customizing classes for all objects</td>
<td>2–7</td>
</tr>
<tr>
<td>Customizing classes for some objects</td>
<td>2–8</td>
</tr>
<tr>
<td>Making customizations to the ADM</td>
<td>2–8</td>
</tr>
<tr>
<td>Instantiation order for super procedures</td>
<td>2–8</td>
</tr>
<tr>
<td>Class Maintenance tool</td>
<td>2–10</td>
</tr>
<tr>
<td>Menu bar</td>
<td>2–11</td>
</tr>
<tr>
<td>Navigation tool bar</td>
<td>2–11</td>
</tr>
<tr>
<td>Search panel</td>
<td>2–11</td>
</tr>
<tr>
<td>TreeView</td>
<td>2–12</td>
</tr>
<tr>
<td>Maintenance pane</td>
<td>2–12</td>
</tr>
<tr>
<td>Class Maintenance Preferences dialog box</td>
<td>2–16</td>
</tr>
<tr>
<td>Class Maintenance tool and class customizations</td>
<td>2–17</td>
</tr>
<tr>
<td>Additional customization tasks</td>
<td>2–19</td>
</tr>
<tr>
<td>Adding the new class to the AppBuilder</td>
<td>2–19</td>
</tr>
<tr>
<td>Adding a custom palette instance</td>
<td>2–20</td>
</tr>
<tr>
<td>Modifying the classes cached at startup</td>
<td>2–20</td>
</tr>
<tr>
<td>Changing the Object type</td>
<td>2–20</td>
</tr>
<tr>
<td>Additional resources</td>
<td>2–23</td>
</tr>
</tbody>
</table>

### 3. Advanced User Interface Design

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced support for object links</td>
<td>3–3</td>
</tr>
<tr>
<td>Using a single toolbar in a multi-page folder</td>
<td>3–3</td>
</tr>
<tr>
<td>Setting up your test window</td>
<td>3–3</td>
</tr>
<tr>
<td>Modifying the default link activation</td>
<td>3–11</td>
</tr>
<tr>
<td>Disabling data links to dependent SDOs</td>
<td>3–13</td>
</tr>
<tr>
<td>Using a GroupAssign link to group pages</td>
<td>3–13</td>
</tr>
<tr>
<td>Modifying visual properties at the master and instance levels</td>
<td>3–14</td>
</tr>
<tr>
<td>Setting a property at the master level</td>
<td>3–15</td>
</tr>
<tr>
<td>Setting properties at the instance level</td>
<td>3–16</td>
</tr>
<tr>
<td>Using the Dynamic property sheet to set properties</td>
<td>3–17</td>
</tr>
<tr>
<td>Attribute value level summary</td>
<td>3–19</td>
</tr>
<tr>
<td>The attribute control and the object type control</td>
<td>3–20</td>
</tr>
<tr>
<td>Disabling and hiding buttons and menu items</td>
<td>3–24</td>
</tr>
<tr>
<td>Disabling actions based on a data value</td>
<td>3–24</td>
</tr>
<tr>
<td>Putting the value check into the window code</td>
<td>3–31</td>
</tr>
<tr>
<td>Defining action rules for menu and toolbar items</td>
<td>3–35</td>
</tr>
<tr>
<td>Understanding the role of the item link</td>
<td>3–38</td>
</tr>
<tr>
<td>Syntax of the action rules</td>
<td>3–39</td>
</tr>
<tr>
<td>Properties typically used in action rules</td>
<td>3–39</td>
</tr>
<tr>
<td>Functions typically used in action rules</td>
<td>3–41</td>
</tr>
<tr>
<td>Defining rules that use your own functions and properties</td>
<td>3–41</td>
</tr>
</tbody>
</table>
6. Using the Progress Dynamics Managers ........................................ 6–1
   Overview of the managers .................................................. 6–3
      Session Manager ....................................................... 6–5
      Configuration File Manager ......................................... 6–5
      Connection Manager .................................................. 6–9
      Profile Manager ....................................................... 6–10
      Localization Manager ................................................ 6–11
      Security Manager ..................................................... 6–11
      Repository Manager and Repository Design Manager ......... 6–11
      General Manager ...................................................... 6–12
      Request Manager ...................................................... 6–12
      User Interface Manager .............................................. 6–13
      Referential Integrity Manager ...................................... 6–13
      Customization Manager .............................................. 6–13
   Manager architecture .................................................... 6–14
      Manager handles ....................................................... 6–14
      Organization of the manager code .................................. 6–15
      How the manager code runs on the server ....................... 6–19
   Using the Session Manager ............................................ 6–21
      Context management .................................................. 6–21
      Property management ............................................... 6–23
      Managing procedures and containers ............................. 6–24
   Using the Configuration File Manager ............................. 6–34
      Using the isICFRunning function ................................... 6–34
      Using the getManagerHandle function ............................ 6–35
      Checking session types and session parameters ............... 6–37
   Using the Connection Manager ....................................... 6–39
   Using the Profile Manager ............................................ 6–41
      Creating user profile codes and types ............................ 6–42
      Creating new browser properties .................................. 6–44
      Creating a custom super procedure for the browser .......... 6–49
      Customizing the initializeObject procedure ................. 6–50
      Creating the Pop-up menu ......................................... 6–54
      Defining the Pop-up menu event procedures .................... 6–56
   Using the Localization Manager .................................... 6–64
      Storing translated text strings in the Repository ............ 6–64
      Using the API calls translatePhrase and getTranslation .... 6–65
      Using multiTranslation and the translation temp-table .... 6–66
   Using the Security Manager ......................................... 6–69
   Using the General Manager .......................................... 6–74

7. Creating a New Manager .................................................. 7–1
   The manager templates ............................................... 7–3
      Customizing an existing manager .................................. 7–5
   Building a new manager in the AppBuilder ....................... 7–5
      Separating client code from server code ....................... 7–6
   Registering your manager ............................................ 7–8
      Creating a new manager type ...................................... 7–9
      Adding your manager to the session types .................... 7–11
      Invoking the session type in your startup command ......... 7–14
8. **Understanding the Repository Object Tables** .................................................. 8–1
   Introduction ........................................................................................................... 8–3
   Architectural principles ...................................................................................... 8–4
   Object IDs in the Repository ............................................................................... 8–5
   Object types, SmartObjects, and instances ....................................................... 8–5
      Object diagram .................................................................................................. 8–6
      Object type table ............................................................................................... 8–6
      SmartObject table ............................................................................................. 8–8
      Object instance table ......................................................................................... 8–12
      SmartObject table example ............................................................................. 8–13
   Attribute tables ..................................................................................................... 8–14
      Attribute group table .......................................................................................... 8–16
      Attribute table .................................................................................................... 8–16
      Attribute value table .......................................................................................... 8–19
      Identifying the level of an attribute value ....................................................... 8–20
   SmartLink tables .................................................................................................. 8–29
      SmartLink type table .......................................................................................... 8–29
      Supported link table ........................................................................................... 8–30
      SmartLink table .................................................................................................. 8–30
   Folder page tables ................................................................................................ 8–31
      Layout table ......................................................................................................... 8–31
      Page table ........................................................................................................... 8–32
      Page object table ............................................................................................... 8–33
   Customization tables ............................................................................................ 8–34
      Customization type table .................................................................................... 8–35
      Customization result table ................................................................................. 8–36
      Customization table ............................................................................................ 8–36
      Joining customizations to the SmartObject table ............................................ 8–37
      Tools to support customization maintenance .................................................. 8–40
   Using the Repository Manager ........................................................................... 8–40
      Client cache ........................................................................................................ 8–41
      Repository Manager API .................................................................................... 8–44
      Retrieving related information for an object .................................................... 8–47
      How objects are instantiated using prepareInstance .................................... 8–49

Index ............................................................................................................................ Index–1
Figures

Figure 1–1: Property sheet—MASTER .................................................. 1–7
Figure 1–2: Filtering objects for a new super procedure ........................ 1–11
Figure 1–3: Customers with a dynamic viewer .................................. 1–18
Figure 1–4: Relationships between objects and super procedures ........ 1–21
Figure 1–5: ProTools palette .............................................................. 1–22
Figure 1–6: Prototype Generator window ......................................... 1–22
Figure 1–7: Improper function reference without TARGET-PROCEDURE 1–26
Figure 1–8: Proper function reference with TARGET-PROCEDURE ........ 1–27
Figure 2–1: Progress Dynamics class hierarchy ................................. 2–3
Figure 2–2: Class Maintenance tool main window ............................. 2–10
Figure 2–3: Class Maintenance Preferences dialog box ....................... 2–16
Figure 3–1: SmartToolBar Properties window .................................. 3–12
Figure 3–2: Dynamic Properties window ......................................... 3–12
Figure 3–3: GroupAssign link example ............................................ 3–14
Figure 3–4: Property sheet for the CustNum field ............................. 3–16
Figure 3–5: Dynamic properties sheet .............................................. 3–17
Figure 3–6: Viewer property sheet ................................................... 3–18
Figure 3–7: Attribute Maintenance window ..................................... 3–21
Figure 3–8: Object Type Maintenance window ................................. 3–23
Figure 3–9: Dynamic Properties window ........................................ 3–25
Figure 3–10: Container Builder for oemaintwin ............................... 3–26
Figure 3–11: Toolbar and Menu designer ......................................... 3–27
Figure 3–12: Property sheet for frMain ............................................ 3–30
Figure 3–13: Test of window with DisabledActions ............................ 3–30
Figure 3–14: Toolbar and Menu Designer ......................................... 3–36
Figure 3–15: Toolbar and Menu Designer: item link definition .......... 3–38
Figure 3–16: Defining an item link .................................................. 3–38
Figure 5–1: Customer record message box ..................................... 5–5
Figure 5–2: Customer Selection window ......................................... 5–15
Figure 5–3: Property sheet for dynamic browser ............................. 5–23
Figure 5–4: Customer Maintenance window .................................... 5–37
Figure 6–1: Progress Dynamics manager architecture ........................ 6–4
Figure 6–2: Executable code in main block ..................................... 6–17
Figure 6–3: Data access file ............................................................ 6–17
Figure 6–4: Context database table definitions ................................. 6–22
Figure 6–5: Sample application window ......................................... 6–27
Figure 6–6: Static Handle field of the Manager Type Control ................ 6–35
Figure 6–7: Manager Type Maintenance - ConnectionManager .......... 6–36
Figure 6–8: Output of testRecordDetail.p ...................................... 6–75
Figure 6–9: FOR EACH query results .......................................... 6–76
Figure 7–1: Section Editor .............................................................. 7–6
Figure 7–2: Standard Repository tables ......................................... 7–16
Figure 7–3: Field Properties window ............................................. 7–17
Figure 7–4: Table Triggers dialog box ............................................ 7–17
Figure 7–5: Section Editor .............................................................. 7–20
Figure 7–6: Message Control window ............................................. 7–29
Figure 7–7: Field Edit Manager session type ................................... 7–32
Figure 7–8: Error message ............................................................. 7–32
Figure 8–1: Object diagram ............................................................ 8–6
Figure 8–2: Order entry maintenance window records ....................... 8–13
Figure 8–3: Attribute table relationships ....................................... 8–15
Figure 8–4: Attribute value and table relationships ......................... 8–21
Figure 8–5: NavigationSourceEvents attribute ............................... 8–22
Figure 8–6: Attributes defined at the object master level ................... 8–23
Figure 8–7: Relationships of attribute value records to other records .... 8–23
Figure 8–8: Attributes defined at the object instance level ......................... 8–24
Figure 8–9: Instance attribute value relationships ........................................ 8–24
Figure 8–10: Object instances in the container builder window ....................... 8–25
Figure 8–11: Class level attribute value ....................................................... 8–26
Figure 8–12: Objects with assigned minimum height values ......................... 8–27
Figure 8–13: Classes with defined initial values for MinHeight ....................... 8–28
Figure 8–14: DisableOnInit properties for oemaintwin .................................. 8–29
Figure 8–15: Link, SmartObject, and object instance tables ......................... 8–31
Figure 8–16: Folder page table diagram ....................................................... 8–34
Figure 8–17: Customization tables .............................................................. 8–35
Figure 8–18: Customization example ............................................................ 8–39
Figure 8–19: Customization Maintenance utility ........................................... 8–40
Figure 8–20: Levels of customization ............................................................ 8–40
Tables

Table 1–1: Qualifying names .................................................. 1–45
Table 1–2: Client logic functions .......................................... 1–46
Table 1–3: lookupCompleteEvent parameters ....................... 1–52
Table 1–4: lookupDisplayCompleteEvent parameters ............. 1–53
Table 4–1: Caching feature combinations ............................. 4–11
Table 4–2: Instance properties and defaults of an SDO data source ........ 4–16
Table 5–1: Default values of resize properties for visual objects ............................ 5–15
Table 7–1: The gsc_entity_field_edit table ............................. 7–16
Table 8–1: The gsc_object_type table .................................. 8–7
Preface

This Preface contains the following sections:

- Purpose
- Audience
- Organization
- Using this manual
- Typographical conventions
- Examples of syntax descriptions
- Example procedures
- OpenEdge messages
- Third party acknowledgements
Purpose

This handbook provides information about various programming topics in Progress Dynamics®. Use it along with OpenEdge Development: Progress Dynamics Basic Development as a guide and reference to programming with Progress Dynamics.

Audience

This guide is designed for any developer familiar with ABL who is interested in building a new OpenEdge application, or rearchitecting an existing application to bring it to a distributed GUI environment.

Organization

This book is organized in the following manner:

Chapter 1, “Writing Super Procedures for Objects”

Describes how to create custom super procedures for dynamic client-side objects, including the kind of code and programming style to use, and introduces an API to simplify the code you write. There is also discussion of dynamic User Interface events, and of Web development considerations.

Chapter 2, “Customizing Classes”

Explains how to extend the Progress Dynamics class hierarchy by adding your own custom classes. Also describes the Class Maintenance tool.

Chapter 3, “Advanced User Interface Design”

Describes a single folder window that illustrates many of the features that support building complex windows and customizing behavior to suit the needs of your application. There is also a discussion of various techniques to use to take advantage of new features.

Chapter 4, “Caching Application Data on the Client”

Shows how to take advantage of various framework features to cache application data.

Chapter 5, “Using ADM2 Properties and Methods”

Provides an overview of the properties and methods of the Application Development Model that are essential to Progress Dynamics application builders. It also provides guidance on how properties and methods are typically used.

Chapter 6, “Using the Progress Dynamics Managers”

Explains the role of Progress Dynamics managers, which are a set of service procedures that support a wide range of application needs. There is a brief overview of the Managers, a description of how they are constructed, and some guidelines on how to use specific Manager API calls in your applications. In addition, there are some examples designed to give you a better understanding of how to use the Managers to provide support for special needs that they do not take care of automatically.
Chapter 7, “Creating a New Manager”

Details the new template procedures and how you can use them to create managers of your own for your applications.

Chapter 8, “Understanding the Repository Object Tables”

Describes the Progress Dynamics Repository tables and their fields in detail in order to provide you with a complete understanding of the Repository database.

Using this manual

OpenEdge provides a special purpose programming language for building business applications. In the documentation, the formal name for this language is ABL (Advanced Business Language). With few exceptions, all keywords of the language appear in all UPPERCASE, using a font that is appropriate to the context. All other alphabetic language content appears in mixed case.

For the latest documentation updates see the OpenEdge Product Documentation category on PSDN http://www.psdn.com/library/kbcategory.jspa?categoryID=129.

References to ABL compiler and run-time features

ABL is both a compiled and interpreted language that executes in a run-time engine that the documentation refers to as the ABL Virtual Machine (AVM). When documentation refers to ABL source code compilation, it specifies ABL or the compiler as the actor that manages compile-time features of the language. When documentation refers to run-time behavior in an executing ABL program, it specifies the AVM as the actor that manages the specified run-time behavior in the program.

For example, these sentences refer to the ABL compiler’s allowance for parameter passing and the AVM’s possible response to that parameter passing at run time: “ABL allows you to pass a dynamic temp-table handle as a static temp-table parameter of a method. However, if at run time the passed dynamic temp-table schema does not match the schema of the static temp-table parameter, the AVM raises an error.” The following sentence refers to run-time actions that the AVM can perform using a particular ABL feature: “The ABL socket object handle allows the AVM to connect with other ABL and non-ABL sessions using TCP/IP sockets.”

References to ABL data types

ABL provides built-in data types, pre-defined class data types, and user-defined class data types. References to built-in data types follow these rules:

- Like most other keywords, references to specific built-in data types appear in all UPPERCASE, using a font that is appropriate to the context. No uppercase reference ever includes or implies any data type other than itself.
- Wherever integer appears, this is a reference to the INTEGER or INT64 data type.
• Wherever decimal appears, this is a reference to the DECIMAL data type.

• Wherever numeric appears, this is a reference to the INTEGER, INT64, or DECIMAL data type.

References to pre-defined class data types appear in mixed case with initial caps, for example, Progress.Lang.Object. References to user-defined class data types appear in mixed case, as specified for a given application example.

**Typographical conventions**

This manual uses the following typographical conventions:

<table>
<thead>
<tr>
<th>Convention</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bold</strong></td>
<td>Bold typeface indicates commands or characters the user types, provides emphasis, or the names of user interface elements.</td>
</tr>
<tr>
<td><strong>Italic</strong></td>
<td>Italic typeface indicates the title of a document, or signifies new terms.</td>
</tr>
<tr>
<td>SMALL, BOLD CAPITAL LETTERS</td>
<td>Small, bold capital letters indicate OpenEdge key functions and generic keyboard keys; for example, GET and CTRL.</td>
</tr>
<tr>
<td>KEY1+KEY2</td>
<td>A plus sign between key names indicates a <strong>simultaneous</strong> key sequence: you press and hold down the first key while pressing the second key. For example, CTRL+X.</td>
</tr>
<tr>
<td>KEY1 KEY2</td>
<td>A space between key names indicates a <strong>sequential</strong> key sequence: you press and release the first key, then press another key. For example, ESCAPE H.</td>
</tr>
</tbody>
</table>

**Syntax:**

<table>
<thead>
<tr>
<th>Fixed width</th>
<th>A fixed-width font is used in syntax statements, code examples, system output, and filenames.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed-width italics</td>
<td>Fixed-width italics indicate variables in syntax statements.</td>
</tr>
<tr>
<td><strong>Fixed-width bold</strong></td>
<td>Fixed-width bold indicates variables with special emphasis.</td>
</tr>
<tr>
<td>UPPERCASE fixed width</td>
<td>Uppercase words are ABL keywords. Although these are always shown in uppercase, you can type them in either uppercase or lowercase in a procedure.</td>
</tr>
</tbody>
</table>

- This icon (three arrows) introduces a multi-step procedure.

- This icon (one arrow) introduces a single-step procedure.

- Period (.) or colon (:)

• All statements except DO, FOR, FUNCTION, PROCEDURE, and REPEAT end with a period. DO, FOR, FUNCTION, PROCEDURE, and REPEAT statements can end with either a period or a colon.

- Large brackets indicate the items within them are optional.
Examples of syntax descriptions

In this example, ACCUM is a keyword, and aggregate and expression are variables:

**Syntax**

```
ACCUM aggregate expression
```

FOR is one of the statements that can end with either a period or a colon, as in this example:

```
FOR EACH Customer:
    DISPLAY Name.
END.
```

In this example, STREAM stream, UNLESS-HIDDEN, and NO-ERROR are optional:

**Syntax**

```
DISPLAY [ STREAM stream ] [ UNLESS-HIDDEN ] [ NO-ERROR ]
```

In this example, the outer (small) brackets are part of the language, and the inner (large) brackets denote an optional item:

**Syntax**

```
INITIAL [ constant [ , constant ] ]
```

A called external procedure must use braces when referencing compile-time arguments passed by a calling procedure, as shown in this example:

**Syntax**

```
{ &argument-name }
```
In this example, EACH, FIRST, and LAST are optional, but you can choose only one of them:

**Syntax**

```plaintext
PRESELECT [ EACH | FIRST | LAST ] record-phrase
```

In this example, you must include two expressions, and optionally you can include more. Multiple expressions are separated by commas:

**Syntax**

```plaintext
MAXIMUM ( expression , expression [ , expression ] ... )
```

In this example, you must specify MESSAGE and at least one expression or SKIP [ (n) ], and any number of additional expression or SKIP [ (n) ] is allowed:

**Syntax**

```plaintext
MESSAGE { expression | SKIP [ ( n ) ] } ...
```

In this example, you must specify `{include-file, then optionally any number of argument or &argument-name = "argument-value", and then terminate with `}:

**Syntax**

```plaintext
{ include-file 
  [ argument | &argument-name = "argument-value" ] ... }
```

**Long syntax descriptions split across lines**

Some syntax descriptions are too long to fit on one line. When syntax descriptions are split across multiple lines, groups of optional and groups of required items are kept together in the required order.

In this example, WITH is followed by six optional items:

**Syntax**

```plaintext
WITH [ ACCUM max-length ] [ expression DOWN ]
[ CENTERED ] [ n COLUMNS ] [ SIDE-LABELS ]
[ STREAM-IO ]
```
Complex syntax descriptions with both required and optional elements

Some syntax descriptions are too complex to distinguish required and optional elements by bracketing only the optional elements. For such syntax, the descriptions include both braces (for required elements) and brackets (for optional elements).

In this example, ASSIGN requires either one or more field entries or one record. Options available with field or record are grouped with braces and brackets:

**Syntax**

```
ASSIGN { [ FRAME frame ] { field [ = expression ] } }
     [ WHEN expression ] } ...
  | { record [ EXCEPT field ... ] }
```

Example procedures

This manual provides numerous example procedures that illustrate syntax and concepts. You can access the example files and details for installing the examples from the following locations:

- The Documentation and Samples CD that you received with your product.
- The OpenEdge Documentation page on PSDN:


OpenEdge messages

OpenEdge displays several types of messages to inform you of routine and unusual occurrences:

- **Execution messages** inform you of errors encountered while OpenEdge is running a procedure; for example, if OpenEdge cannot find a record with a specified index field value.
- **Compile messages** inform you of errors found while OpenEdge is reading and analyzing a procedure before running it; for example, if a procedure references a table name that is not defined in the database.
- **Startup messages** inform you of unusual conditions detected while OpenEdge is getting ready to execute; for example, if you entered an invalid startup parameter.
After displaying a message, OpenEdge proceeds in one of several ways:

- Continues execution, subject to the error-processing actions that you specify or that are assumed as part of the procedure. This is the most common action taken after execution messages.
- Returns to the Procedure Editor, so you can correct an error in a procedure. This is the usual action taken after compiler messages.
- Halts processing of a procedure and returns immediately to the Procedure Editor. This does not happen often.
- Terminates the current session.

OpenEdge messages end with a message number in parentheses. In this example, the message number is 200:

```
** Unknown table name table. (200)
```

If you encounter an error that terminates OpenEdge, note the message number before restarting.

**Obtaining more information about OpenEdge messages**

In Windows platforms, use OpenEdge online help to obtain more information about OpenEdge messages. Many OpenEdge tools include the following Help menu options to provide information about messages:

- Choose Help → Recent Messages to display detailed descriptions of the most recent OpenEdge message and all other messages returned in the current session.
- Choose Help → Messages and then type the message number to display a description of a specific OpenEdge message.
- In the Procedure Editor, press the HELP key or F1.

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Writing Super Procedures for Objects

A basic principle of the Progress Dynamics® framework is to create an application from mostly dynamic, or data-driven components. In *OpenEdge Development: Progress Dynamics Basic Development*, you can see how to generate dynamic Browsers and Viewers, and how to assemble these into dynamic Windows with Folders and dynamic Toolbars.

A major goal of providing all these dynamic objects is to minimize the amount of code in your application that you need to write, maintain, and deploy. This leaves open the question of where you do put code when you have to write it. And of course you do have to write code of many kinds to complete any application. The Progress Dynamics framework provides most of the default behavior you need, but not application-specific business logic.

The discussion of the SDO logic procedure in *OpenEdge Development: Progress Dynamics Basic Development* answers the question for the SDO: in order to free most SDOs from static code and to be dynamic objects, you should write business logic and validation logic in a separate procedure that is run along with your dynamic SDO instance, and made a super procedure of the SDO.

The same technique applies to other dynamic objects as well. If you have dynamic Viewers and Browsers in your client user interface and they need to respond to events with custom code, you can put that code into a separate procedure, which you designate as the *custom super procedure* for the object. At run time, the super procedure is run along with the instance of the dynamic object, and it responds to events in the object by running custom code.
This chapter describes how to create custom super procedures for dynamic client-side objects and what kind of code you should consider putting into them (and not putting into them), and suggests a programming style and introduces an API that together simplify the code you write. It also discusses dynamic user interface events, as well as how to anticipate providing your application with a Web browser user interface in Progress Dynamics Version 2.

This chapter includes the following topics:

- Client-side code
- Using custom super procedures in Progress Dynamics
- Defining a custom super procedure for an object
- Writing code for a custom super procedure
- Defining user interface events in Progress Dynamics
- Moving client logic support to an extended class
- Running a PLIP from client logic
- Building a custom super procedure for a browser
- Using the client logic API
- Organizing logic at the level of procedures or functions
- Customizing dynamic lookup behavior in viewers
Client-side code

This section provides some examples and programming guidelines for you, including:

- Client-side code in a distributed application.
- Using super procedures for client code.

Client-side code in a distributed application

Progress Dynamics is designed in every way to support distributed applications, where the user interface runs in a client session separate from an AppServer™ session that is connected to the database. This means that direct database references must be avoided completely in any ABL code to be executed on the client. It means that client-side events that force an AppServer call to retrieve information should be kept to a minimum for the best performance. It also means that, in general, client-side executable code should be kept to a minimum to reduce the number of procedures that must be deployed to client machines to run the application.

So, if client-side code cannot reference the database and should not call back to the AppServer except when necessary, what remains for the client code to do?

There are still likely to be many instances in which something particular to your application has to happen on the client, for example, an event that is triggered on the client and must be responded to on the client. On CHOOSE of a button, your code might need to check the value of the field and enable or disable other fields on the screen, or enable or disable menu items or buttons for certain related actions. You might need to modify the interface details of the screen in other ways, modifying colors depending on field values, displaying related text, and so on. These are all legitimate actions that rightly belong in the client-side code.

In some cases it is also necessary to make a call back to the server to obtain information or cause a server-side database action. As noted, these calls should be kept to a minimum to keep application performance from suffering in a widely distributed application, where every AppServer hit is costly. Generally, the amount of data passed between client and server is less of a performance issue than the number of AppServer requests, so keep this in mind when you are developing your code. If a data value that a user enters into a field requires that related data be retrieved from the server, and if this cannot be done until the field value is known, then go ahead and do it. If there are toolbar buttons or menu items, or other buttons in your application screens that retrieve data from the AppServer, then you can provide trigger code to handle this. Just ask yourself in each case whether the call is really necessary, and whether it can be combined with other calls.

This might mean a major adjustment in your thinking, especially for developers who have created host-based or client/server applications in earlier versions of ABL, where the user interface logic is usually compiled right into the user interface itself, and where the database is always available for immediate access. In this environment, it is simple and appropriate to write field validation trigger code in the Data Dictionary that is compiled into the procedure along with the frame that contains the field. This code is executed ON LEAVE OF every field in the frame that has validation logic. It makes a reference to the database, often to do a CAN-FIND to make sure that a value typed into a foreign key field (such as Order.CustNum in the Sports2000 database) is a valid value from another table (such as Customer.CustNum).
In a distributed environment, making a call to the database means making a call to a separate server session, and doing this ON LEAVE OF many fields on a screen would incur a terrible performance cost. This does not mean that users are left without the feedback and validation they are used to from older applications. It simply means that your application design has to take a different approach to providing this kind of feedback. The dynamic lookups and combos in Progress Dynamics are one mechanism for providing and improving on CAN-FIND support without the immediate database lookup. A dynamic combo provides a list of all possible values for a field, assuring that the user will choose one correctly, and the lookup does the same for larger data sets, going back to the server only if the data set is too large to retrieve in a single batch and is not already cached on the client.

In other cases, calculations that might have been done on the fly in the user interface code in an earlier application can be done in advance and sent as calculated fields in the SDO in a single call, along with the rest of the data.

Another consideration is that code that requires database access on the client, apart from the integrity checks that combos and lookups do, is likely really business logic of one kind or another. Putting code of this type on the client violates another principle of distributed application: that business logic belongs on the server, either in SDOs (and their logic procedures), SBOs, or other procedures that can be accessed from anywhere on the client. Embedding business logic in the UI means that it will not be automatically executed from some alternative UI, whether it is another screen in the same application or an alternative UI altogether, such as for a Web browser interface. It also adds to the maintenance headaches you face when you have to modify your application’s behavior.

In any case, the following basic goals remain the same:

- Minimize special code written for the client.
- Minimize unnecessary AppServer calls.
- Keep business logic out of the client code altogether, whenever possible.

**Using super procedures for client code**

The basic reason for using super procedures in a dynamic application is obvious: if your application object is fully data-driven, there is nowhere else to put it! There are a number of advantages to putting your custom code into a small, specialized procedure, while leaving all the standard behavior to dynamic Objects.

First, the compiled static SDO is a large procedure with a substantial amount of code providing a temp-table definition, query, and a number of update operations compiled specifically for that query and table. The internal procedures that provide custom validation logic are probably only a small percentage of the r-code generated for the SDO. You can greatly reduce the r-code that is deployed with your application by taking advantage of the dynamic SDO.

In addition, with your logic separate from the procedure that does the specific job of moving data back and forth between client and server, it can be executed more easily from elsewhere in your application, even when no SDO at all is involved. This is part of the reason why the SDO programming convention was modified to provide new validation hooks that can access an updated record by a more generally useful name of b_ plus the primary table name, rather than using the SDO-specific naming convention of calling it RowObjUpd.
Using custom super procedures in Progress Dynamics

The SDO’s logic procedure is just a specific example of a custom super procedure. It runs with some special wrapper code to make the updated record’s buffer available to the validation procedures, but otherwise it runs as a super procedure of the SDO and can contain any other code that is useful.

The same principle of writing super procedures also applies to other kinds of objects, including dynamic SmartDataViewers™. First, the r-code footprint of the deployed application is greatly reduced. Secondly, because the Viewers and their fields are represented in the Repository, this abstract definition of the Viewer is available to the UI Manager as a basis for a Web browser interface or other alternative interface. Having all the data in the Repository is beneficial in the following other ways as well:

- To support various tools that need to know where fields are used.
- To help you understand what objects contain what other objects.
- To provide standard event behavior for a field no matter where it is used.

For these reasons, it is advisable to develop your applications with any required client-side logic in custom super procedures. In addition, other client-side objects like Browsers, as well as Windows, Folders, and Toolbars, are already dynamic, and the same techniques can apply to writing code to support these objects as well.

Using custom super procedures in Progress Dynamics

This section, which explains how to create super procedures in Progress Dynamics and attach them to your objects, starts with a review of just what super procedures are and how they work.

Super procedures provide a measure of inheritance and class behavior within ABL. Code in a super procedure becomes an extension of the code written in another procedure, so to the extent that a single super procedure can be associated with many other procedures, it can give all of those other procedures the same standard behavior. The super procedure needs to be run only once within a session, where it can support any number of other procedures.

On the face of it, a super procedure looks just like any other ABL procedure. It contains no special code and no special declarations. It is run as a persistent procedure within a session, and can be started by the first procedure that needs it, or by any other mechanism. What makes it a super procedure is a method in the other procedure that wants to inherit its code, the ADD-SUPER-PROCEDURE method on the procedure handle. In this example, a procedure called baseproc.p runs the super procedure superproc.p and then makes the association:

```ABL
DEFINE VARIABLE hSuper AS HANDLE NO-UNDO.
RUN superproc.p PERSISTENT SET hSuper.
THIS-PROCEDURE:ADD-SUPER-PROC(hSuper).
```

At this point, the ABL Virtual Machine (AVM) associates superproc.p and all its internal procedures and functions with baseproc.p. Any RUN statement in baseproc causes the interpreter to search first in baseproc.p and then in superproc.p for the entry point. It executes the first one it finds. In this way the contents of the super procedure transparently act as if part of the base procedure.
In addition, because baseproc.p and superproc.p are in fact separately compiled procedures, each has its own namespace for procedure and function names, as well as for variables and other language constructs. This means that the same internal procedure or function name can appear in both procedures. The super procedure can provide standard behavior in the form of an internal procedure or function, and then the base procedure can override that behavior or augment it.

To do this, the procedure or function in the base procedure must use the syntax RUN SUPER (for an internal procedure) or SUPER() (for a function) to invoke the standard behavior.

The interpreter locates and executes the occurrence of the procedure or function in the base procedure first, and then counts on the base procedure to invoke the same entry point in the super procedure if it wants to. Any other code can come before or after the RUN SUPER statement.

A base procedure can add any number of super procedures, just by invoking the ADD-SUPER-PROC method multiple times. The procedures are kept in a kind of last-in-first-out (LIFO) stack, so the last one added is the first one searched for an entry point. When a super procedure is added to a stack, if that procedure also has super procedures, they too are added to the stack. Each one can pass control up the stack with its own RUN SUPER statement.

### Defining a custom super procedure for an object

The super procedure mechanism has been used to provide SmartObjects™ with their standard behavior for the ADM, and this has been extended with Progress Dynamics. One extension is to provide a field in each SmartObject definition where the developer can define a custom super procedure for it. These are called custom super procedures precisely because the intention is to provide an individual application object with customized behavior not inherited from its standard super procedures and from other code in the framework. So as opposed to the model summarized in the previous section, where a single super procedure can provide common code to support many base procedures, the typical use of a custom super procedure in a Progress Dynamics application is likely to be to provide specific code needed by a single client-side viewer, browser, or other object.

To be sure, this is not always the case. A custom super procedure can provide common support for any collection of other objects, for example, if they have fields in common or special field types and event handling needs in common. But if you find yourself attaching the same custom super procedure to a large number of application objects, you can add that behavior to all the objects as a class customization rather than to the individual objects.

If you want to add behavior to all objects of an existing type in your application, such as all viewers or all browsers, then you can define a super procedure in the adm2/custom directory to extend the class’s behavior by adding another super procedure to every object of the type. This is the same method of class extension available to non-Progress Dynamics ADM2 applications. See OpenEdge Development: AppBuilder for more information.

On the other hand, if some group of objects needs the behavior but others do not, then you can use the Class Maintenance tool to define a subclass, so you have two distinct types of objects: one with the behavior and one without. See Chapter 2, “Customizing Classes,” for more information about different techniques for extending the object hierarchy.
Some Progress Dynamics objects allow you to define a custom super procedure in the property sheet or other tool for creating objects of that type. For example, after you have created a set of browsers using the Object Generator, you can open each one that requires custom code by using the **Open Object** button in the AppBuilder. Or you can define a browser from scratch using the **New** button in the AppBuilder. Either way, you enter the AppBuilder’s property sheet for the browser, where you can name a custom super procedure, as you can see in Figure 1–1.

![Property Sheet - armculib](image)

**Figure 1–1: Property sheet—MASTER**

Custom super procedures can also be specified on the **Save** dialog box for objects in AppBuilder.

Remember that because the super procedure must be registered in the Progress Dynamics Repository like any other object, you do not need to specify the relative pathname of the procedure. This is stored as part of the definition of the procedure as a Repository object.

The AppBuilder allows you to set the custom super procedure for other objects you edit there, such as SmartDataViewers. Likewise, the Container Builder lets you define the custom super procedure for a dynamic window.

**To use the Repository Maintenance tool to define a super procedure:**

1. Run the Repository Maintenance tool from the AppBuilder **Build** menu.
2. Enter the **Object Name** of the object and click **Apply**.
3. Expand both the top-level node in the TreeView, the **Objects** node, the **Attributes** node under that, and click **SuperProcedure**.
4. This brings you to the Attribute Value Maintenance window, where you can enter the name of the object’s custom super procedure in the Attribute value field:

Note that you can define custom super procedures in this way for both static and dynamic objects. If you want to associate extended behavior with multiple objects of a type (as an alternative to truly subclassing the type), you can simply add the super procedure to all the objects it should affect. Remember that if you want to add new attributes for the super procedure code to use, you must first add the attributes to the Repository (in the Attribute Maintenance tool), and then add them to the object type you are extending (in the Class Maintenance tool or in the Repository Maintenance tool).

And remember that a dynamic object is simply an instance of a single procedure, such as `ry/obj/rydynviewv.w` for dynamic viewers, that can read the right records out of the Repository to instantiate the object at run time. This one physical ABL procedure serves all dynamic objects of the type. Thus there is always a procedure handle to associate with a super procedure, whether the object is dynamic or static. In the static case there is a separate source and compiled procedure for each object; in the dynamic case there is only one for all objects of a type.

**Writing code for a custom super procedure**

The nature of the super procedure also creates a programming challenge. Because the base procedure object and the super procedure are separately compiled objects, with their own name spaces, you cannot simply refer to frames in the base object. References to fields, variables, buffers, and other constructs are not automatically available to the super procedure, so the code that references them must change, and in general becomes somewhat more complex.
Writing code for a custom super procedure

The ADM2 solves this problem for the SmartObjects themselves by defining a set of properties for each SmartObject type, whose values are stored in a temp-table record within the scope of the object. The \{get\} and \{set\} include files and the \texttt{get<property>} and \texttt{set<property>} functions provide access to those property values from other procedures, including in particular the object’s super procedures.

In your application code, you need to do something similar to get access to the objects or widgets inside a viewer or browser.

\textbf{Note:} In the context of an ABL application, the term widget has a very specific meaning, namely, any basic ABL object with its own object handle. Thus not only are fill-in fields and other visualizations of data fields widgets, but so are other types of controls such as buttons, as well as objects like rectangles that would never be thought of as controls.

You cannot simply refer to field names or button names from a super procedure attached to a Viewer or Browser. This section introduces a simple way to encapsulate that access in such a way that it can be used from any visual object’s super procedure, and so acts as an API for writing super procedure code. The complete API, which will be explained later in this chapter, will be a standard part of Version 2 of Progress Dynamics, to help standardize and simplify writing client-side code.

To illustrate the different ways that you can write super procedure logic, parts of the API are built up in the following steps:

- Defining logic in a single custom super procedure.
- Creating a new super procedure.

\section*{Defining logic in a single custom super procedure}

The first example is for a window managing the Customer table using the customerfullo SDO. The examples use objects from other parts of the documentation. If you need some of the base objects, you can simply build them. If your objects have different names, just adjust accordingly.

Suppose you want to define a user interface condition so that if the customer’s credit limit does not exceed the balance by at least $5,000, the Balance field is highlighted to show this. This check must be made whenever a row of data is displayed in the viewer, and also when the Credit Limit or Balance field is modified.
In a static viewer, you could simply write a simple statement into a local override of the displayFields procedure, which is executed each time a row is displayed. For example:

```plaintext
PROCEDURE displayFields:
/*-------------------------------------------------------------------------
| Purpose:     Super Override of displayFields                      |
| Parameters:  pcColValues AS CHARACTER                         |
| Notes:       Highlights the Balance if it's too close to CreditLimit. |
-------------------------------------------------------------------------*/

DEFINE INPUT PARAMETER pcColValues AS CHARACTER NO-UNDO.
RUN SUPER( INPUT pcColValues).

DO WITH FRAME {&FRAME-NAME}:
   IF DECIMAL(RowObject.CreditLimit:SCREEN-VALUE) -
      DECIMAL(RowObject.Balance:SCREEN-VALUE) < 5000.00 THEN
      RowObject.Balance:BGCOLOR = 14. /* Highlight the field in yellow. */
   END.
END PROCEDURE.
```

Note that there are some complications to writing code like this, because the viewer does not actually have access to the database record, or even the RowObject temp-table record. Because it is strictly a thin client object, the field values are simply copied into the screen values of the fields on display, and copied from there back to the associated SDO on save. So your code must use the SCREEN-VALUE attribute of each field to get at its value and then convert it to the proper data type. Also, note how the code scopes the field references to the default viewer frame name, which is represented by the preprocessor &FRAME-NAME.

If you want this same code to be executed ON LEAVE OF the Balance and CreditLimit fields, you can define a UI trigger for those events in the AppBuilder and associate the same code with them. In that case, it makes sense to move the code itself into a separate procedure to call from both places.

This kind of code is not available to a dynamic Viewer because there is no place to write the code. So you have to move the code to a custom super procedure you associate with the Viewer instance. In this case, the fields such as RowObject.CreditLimit are not directly available to the compiler when it compiles your super procedure, so you cannot reference them. Instead, your code must access the fields with the client API, which again is an instance (a running copy) of the single procedure rydynviewv.w, which reads data for your specific Viewer out of the Progress Dynamics Repository and creates the Viewer for you at run time.
Creating a new super procedure

To create a new super procedure, click **New** in the AppBuilder and select **Custom Super Procedure** from the list of procedure objects. Figure 1–2 shows how you can filter the kinds of objects the AppBuilder can create for you, in this case just showing procedure files.

![Filtering objects for a new super procedure](image)

The brief procedure wizard simply prompts you for documentation information that it writes into the top of the procedure file. After you write your code and save the procedure, you must associate it with the viewer in the AppBuilder’s property sheet for the viewer.

Defining user interface events in Progress Dynamics

The example you have created attaches an action to an ADM event, the `displayFields` event. This defines when it is executed relative to the overall sequence of SmartObject events. In addition, you will often want to define actions that occur when a user interface event occurs, such as choosing a button or changing a value. Progress Dynamics supports the definition of these UI events, so that you can associate code with events in dynamic objects.

You can define UI events for objects such as a dynamic viewer using the dynamic property sheet in the AppBuilder. For more information, see *OpenEdge Development: Progress Dynamics Basic Development*.

Note that Repository data is not created for the fields in a static viewer, although the viewer itself and its attributes are registered in the Repository, allowing you, for example, to define a custom super procedure for the static viewer. When you create a dynamic viewer using the Object Generator or the AppBuilder, not only is the viewer itself registered in the Repository, but there is a whole set of object and attribute values created for each of the fields and other objects in the viewer. It is this data that the dynamic viewer procedure uses to instantiate the viewer at run time. If you want to define UI events for field events such as `VALUE-CHANGED`, you can do this only for dynamic viewers, not static ones.
Next, you must construct a window with a dynamic viewer in it to use to continue the client logic example. There is a layout template already defined in the Repository that you can use as a basis for a simple test window. It has the rather dense but all-inclusive name rywinbrsdynvw. This window has slots for an SDO, a dynamic browser, and a dynamic viewer, in addition to the standard toolbar.

To create a Customer test window:

2. Type custdynwin as the Container name.
3. Specify rywinbrsdynvw as the Container Template.
4. Replace the template SDO, browser, and viewer with those the Object Generator created for the Customer table:

5. Save the new container.

Modifying the Object Generator defaults for a dynamic object

A slight digression is needed to get a reasonable looking dynamic viewer. If you run the dynamic window you just created, you might see that all the Customer fields in the viewer are in a single column, making for a very tall and awkward-looking viewer. This is a result of the viewer settings you chose when you ran the Object Generator. You can edit the viewer in the AppBuilder to arrange the fields as you want them, but it is still helpful to improve the default layout so that there is less to change later on.
To reduce the number of fields in a column:

1. Return to the Object Generator by choosing Build→Object Generator.

2. Set the OE Product Module.

3. Uncheck the Data objects toggle box. Existing SDOs in your selected module are displayed in the browse.

4. Select just the Customer SDO in the browse, and activate the Viewers toggle box:

5. Choose the Viewers tab. Select the OE Product module and set the Maximum fields per column to a smaller number, perhaps 6 or 8:

6. Click Start to re-create the dynamic viewer.

When the generation is complete, you have a new dynamic Customer viewer with three columns, a better default appearance for most windows. Figure 1–3 shows how this viewer will look when you run the completed example later on.
Defining UI events for the viewer

You can define UI events to which you associate code to execute when the event occurs. This is how you get a user interface trigger in a dynamic object to run procedural code in a custom super procedure that you attach to the object. You can define these events either in the Repository Maintenance tool or, more simply, in the dynamic property sheet.

To define UI events for the window in the Repository Maintenance tool:

1. Open the Repository Maintenance tool and open the record for armcuviewv.
2. Select DynView → Objects → armcuviewv → Object Instances. When you expand Object Instances, you see the field-level objects representing all the fields in the viewer.
3. Expand customer_credit_limit.
4. Expand the UI Events node to see that none are defined:

   ![Repository Maintenance Tool](image)

5. Right-click on the UI Events node and choose Add UI Events on the pop-up menu.

   The maintenance frame that then appears on the right allows you to define one or more UI events for the Credit Limit field. These are the fields you must fill in:

   - **Event Name** — This is the name of the ABL event you want to associate code with, for example: ENTRY, LEAVE, VALUE-CHANGED.

   - **Action Type** — Type RUN if you want to run an internal procedure when the event occurs. Type PUBLISH if you want to publish an ABL named event when the UI event occurs (which could be an ADM2 event such as fetchNext or some named event you have defined yourself, and to which your object subscribes). These are the only two valid values for Action Type.
• **Action Target** — This defines the context in which the event should occur. You can specify one of the values in the following table for the Action Target:

<table>
<thead>
<tr>
<th>Target</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SELF</td>
<td>This means that the event should be run or published in the context of the object the code is serving, which effectively means it will be executed in the TARGET-PROCEDURE of the custom super procedure.</td>
</tr>
<tr>
<td>CONTAINER</td>
<td>This means that the event should be run or published in the context of the object that contains the object the custom super procedure is attached to; this is effectively the Container-Source of the object, normally its dynamic SmartWindow.</td>
</tr>
<tr>
<td>ANYWHERE</td>
<td>This value is valid only if the Action Type is PUBLISH, which means that the PUBLISH will be done from the custom super procedure itself and not FROM TARGET-PROCEDURE or FROM &lt;ContainerHandle&gt;. Since objects do not (and should not) normally subscribe to named events in super procedures directly, this effectively means that the event will be received only by an object that subscribes to it with the keyword ANYWHERE, meaning from any publisher.</td>
</tr>
<tr>
<td>AS</td>
<td>This and all the remaining values are valid only if the Action Type is RUN. The value AS means that the action will be run in the default AppServer handle for the client session.</td>
</tr>
<tr>
<td>SM</td>
<td>This value means that the action will be run in the Session Manager.</td>
</tr>
<tr>
<td>SEM</td>
<td>This value means that the action will be run in the Security Manager.</td>
</tr>
<tr>
<td>PM</td>
<td>This value means that the action will be run in the Profile Manager.</td>
</tr>
<tr>
<td>RM</td>
<td>This value means that the action will be run in the Repository Manager.</td>
</tr>
<tr>
<td>TM</td>
<td>This value means that the action will be run in the Translation/Localization Manager.</td>
</tr>
<tr>
<td>GM</td>
<td>This value means that the action will be run in the General Manager.</td>
</tr>
</tbody>
</table>

• **Event Action** — This is the name of the internal procedure to be RUN, or the named event to be published.

• **Event Parameter** — This is the value of an optional parameter of type CHARACTER that will be passed to the procedure when run or published, if specified. If this is not specified, then the procedure is run or the event is published with no INPUT parameter.

• **Event Disabled** — If this toggle box is activated, then the event is disabled and will not occur.
To define a LEAVE event for the Credit Limit field that will execute the same check that happens on RowDisplay:

1. Type LEAVE for the Event Name, type RUN for the Action Type, type SELF for the Action Target, and type CreditLimitLeave for the name of the Event Action procedure. Leave the Event Parameter blank and do not activate the Event Disabled toggle box:

2. Click Save to register your event in the Repository.

To use the Dynamic property sheet to define events:

1. Open the dynamic viewer in the AppBuilder and select the CreditLimit field in the design window.

2. Open the Dynamic property sheet from the Windows menu.

3. Choose the Events tab in the property sheet and enter the same values as described above for the LEAVE event of the Credit Limit field:
Naming conventions for UI events and custom super procedures

There is a reason for the form of the name CreditLimitLeave. The Migration utility converts static viewers to dynamic ones. In doing this, it not only creates all the appropriate Repository data to register the viewer and to represent its fields and all of their attributes, but it also strips any custom code from the static viewer and writes it to a custom super procedure. Any trigger code defined for user interface events is placed into internal procedures using the naming convention of <WidgetName><EventName>. Hence a UI trigger that is defined ON LEAVE OF CreditLimit in a static viewer will cause the Migration utility to generate an internal procedure called CreditLimitLeave with the same code in it, and place this into the custom super procedure for the viewer. There is no absolute need for you to use the same naming convention, since if you follow the guidelines of this chapter, you will be creating super procedures for your static viewers yourself, so that there will be no code left for the Migration utility to convert. Nonetheless, if you follow this naming convention in creating procedures in your custom super procedures, your code will be consistent with what the Migration utility does for static procedures that need converting.

Obviously, the code the Migration utility strips out of existing viewers and puts into a super procedure is not likely to compile or run correctly without modification, because of the issues discussed in this chapter. The intention is simply to salvage the existing code and move it to a place where the developer can then edit it as necessary to make it work in the context of a super procedure.

In addition, the Migration utility creates a default super procedure for each converted static object that has the base table name of the SDO for the object plus the extension super.p. So in this case, if you call your super procedure customersuper.p, it will match the naming convention used for converted objects.

Writing the supporting procedures for the UI event

Now you must edit the customersuper.p procedure to add the internal procedure to be executed when the UI event occurs so that CreditLimitLeave checks first to see if the CreditLimit field has been modified. First create a support function, called widgetModified, to take care of that check. This function checks the ABL MODIFIED attribute for the field and returns true or false accordingly, as shown:

```
FUNCTION widgetModified RETURNS LOGICAL
  ( pcField AS CHARACTER ) :
  /*-------------------------------------------------------------------------
  Purpose: Returns TRUE if the widget value has been changed.
  Params:  pcField AS CHARACTER
  --------------------------------------------------------------------------*/
  DEFINE VARIABLE hField AS HANDLE NO-UNDO.
  hField = widgetHandle(pcField).
  IF VALID-HANDLE(hField) AND CAN-SET (hField, 'MODIFIED') AND
  hField:MODIFIED THEN
    RETURN TRUE.
  ELSE RETURN FALSE.
  END FUNCTION.
```
The next step is to code the `CreditLimitLeave` procedure itself. In this example, the same condition is duplicated from the `rowDisplay` procedure. Obviously, in a properly completed example this code should be pulled out into a separate internal procedure called from both places, as shown:

```
PROCEDURE CreditLimitLeave:
/*-------------------------------------------------------------------------
| Purpose:     Check the CreditLimit against the balance on LEAVE.        |
| Parameters:  <none>                                                    |
-------------------------------------------------------------------------*/
IF widgetModified('CreditLimit') THEN
    IF DECIMAL(widgetValue('CreditLimit')) -
      DECIMAL(widgetValue('Balance')) < 5000
      THEN highlightWidget('Balance').
    ELSE unhighlightWidget('Balance').
END PROCEDURE.
```

**Testing the dynamic viewer with the UI event**

Now if you launch your container window with the dynamic viewer, you can position to a Customer satisfying the condition and see the result. You can also see the effect of creating a dynamic viewer with three columns of fields, as shown in Figure 1–3.

![Figure 1–3: Customers with a dynamic viewer](image)

**Moving client logic support to an extended class**

This chapter begins with a simple example with all client-side code in a custom super procedure for a single viewer. Realistically, much of that support code belongs in an extended viewer class, so that it can serve all viewers. This section illustrates the distinction between a single custom super procedure and a more generic procedure that serves a whole class of objects.
Moving client logic support to an extended class

To extend the viewer class:

1. Copy src/adm2/custom/viewercustom.i and viewercustom.p to a local directory with the same relative path.

2. Edit viewercustom.i to uncomment the line in the Main Block that starts the super procedure viewercustom.p:

3. Move the generically useful code in your custom super procedure to your local copy of viewercustom.p. The support functions shown so far are:
   - widgetHandle
   - widgetValue
   - widgetModified
   - highlightWidget
   - unhighlightWidget

4. Move the code that sets the variables where the lists of widget names and handles are stored. In the original customersuper.p example, this is done in initializeobject. But will this still work when the code is in a super procedure that is part of an extension to the whole viewer class? No, it will not, because the new viewercustom.p procedure might be supporting multiple viewers at once. As a result, these lists and any other viewer attributes that the code accesses must be re-established each time a request comes from a viewer. This is the first of several basic principles to keep in mind when creating a super procedure.

   **Note:** When writing code for a super procedure, always consider whether it will be attached to a single other procedure, or whether it can be attached to multiple other procedures.

In your customersuper.p, the super procedure would only be attached to a single instance of one specific viewer, so it was sufficient to establish needed attribute values on startup in initializeobject. In a more general-purpose procedure, you have to support switching the context of the object the code is supporting on each request, so that it will work properly when there is more than one object using the single super procedure instance. In this case, this means that the code to save off attribute values must go somewhere where it will be executed each time there is a request. In this case, this can be a local version of the displayFields procedure, since the rowDisplay procedure that does any and all checks on display of a new row is called from there.
The following is a version of `displayFields` for the `viewercustom.p` procedure. This version gets the attribute values, saves them off, calls `rowDisplay`, and then resets the local variables so there is no danger of a stray call using stale values, as shown:

```abl
PROCEDURE displayFields:
  /*-------------------------------------------------------------------------
   Purpose:     Runs a rowDisplay procedure if there is one to allow
                custom logic to support any viewer.
   Parameters:  pcColValues AS CHARACTER.
   Notes:       *-------------------------------------------------------------------------
   DEFINE INPUT PARAMETER pcColValues AS CHARACTER NO-UNDO.
   RUN SUPER (INPUT pcColValues).  /* Execute the standard display behavior. */
   */
   /* Establish the list of fields and handles. */
   {get AllFieldNames gcFields}.
   {get AllFieldHandles gcHandles}.
   RUN rowDisplay IN TARGET-PROCEDURE NO-ERROR.
   ASSIGN gcFields = ""
   gcHandles = "".
END PROCEDURE.
```

When you create this, define the variables `gcFields` and `gcHandles` in the **Definitions** section of the procedure so they are scoped to the procedure. Note that because of the principle of designing super procedures to support multiple other procedures, you must do this very cautiously. Generally, it is not good practice to have **any** variables or other constructs scoped to the super procedure itself, because the values might not apply to the next request of the super procedure, which might come from a different object. In this case, it is something of an optimization to write the code in such a way that, within the context of a single call to `displayFields`, all references to these variables will be valid, so it is better to retrieve them once rather than in every single call to the `widgetHandle` function.

The block of code that sets the variables and calls `rowDisplay` first checks to see whether that procedure has been implemented at all. This is always good practice when you are extending the behavior of any object or class. This could be stated as a second super procedure principle.

**Note:** When extending the behavior of an object or a class of objects using a super procedure, be sensitive to making the additional behavior both optional and efficient.

In this case, the specific `rowDisplay` for a viewer will probably be implemented in a custom super procedure for that viewer. Some viewers might have this procedure and some might not. So the behavior is made optional here because the statement to `RUN rowDisplay` is done **NO-ERROR** so that there is no error if it is not defined in the `TARGET-PROCEDURE`. Simply adding a **NO-ERROR** qualifier on a `RUN` statement will often be sufficient to make sure that your extension will not break the code in objects that do not use your extension.

Note that you cannot check for `rowDisplay` by looking for it in the ABL procedure handle attribute `TARGET-PROCEDURE:INTERNAL-ENTRIES` because this ABL attribute returns only those entry points that are actually coded in the `TARGET-PROCEDURE`, or for which there are prototypes compiled into the procedure. In this case, the `TARGET-PROCEDURE` is the viewer procedure, and `rowDisplay` will normally be implemented in its custom super procedure, so the entry point won’t be found, as shown in Figure 1–4.
There is one more critical detail in the RUN statement, and that is the reference to TARGET-PROCEDURE. This brings up the third key point in working with super procedures.

**Note:** Always remember to invoke internal procedures and functions IN TARGET-PROCEDURE from a super procedure. The same applies to PUBLISH and SUBSCRIBE statements in super procedures.

This is one of the most common errors made when people write code for super procedures or, even worse, when people move code from an object procedure such as a static viewer to a super procedure that supports it. Code that worked fine before can simply stop working (that is, stop being executed at all) for this reason. Always keep this relationship between object and super procedure in mind.

*Figure 1–4* shows the relationships between the procedures in this case.

---

**Figure 1–4: Relationships between objects and super procedures**

In addition to the standard set of super procedures starting with `smart.p` and ending with `viewer.p`, the Customer viewer has two additional super procedures, `viewercustom.p`, which applies to the whole class, and `customersuper.p`, which applies just to the one viewer. This is the case whether the base object procedure is a static viewer such as `custstviewv.w`, or an instance of the generic dynamic viewer procedure `rydynviewv.w`. Any statement invoked IN TARGET-PROCEDURE starts at the viewer procedure itself and works its way up the stack until it finds an implementation of the entry point being run. If this entry point has a RUN SUPER statement in it, then it continues up the object’s super procedure stack looking for the next version of it.
Note that the super procedures themselves are not super procedures of each other. So any call that wants to find an implementation of an entry point in the stack must be made IN TARGET-PROCEDURE. The TARGET-PROCEDURE of the customer-specific super procedure customersuper.p is the viewer itself. The TARGET-PROCEDURE of the generic viewercustom.p is likewise the viewer itself.

The statement RUN rowDisplay IN TARGET-PROCEDURE attempts to run it in the viewer procedure. According to recommended coding practice, rowDisplay will not be found there because there is no custom code in the viewer itself, even if it is a static procedure. But the AVM then looks up the viewer’s super procedure stack and finds rowDisplay in customersuper.p, and executes it there.

This leads to an interesting problem with this structure where ABL functions are concerned. The AVM must have a function definition for any static function reference in a procedure’s code. The only alternative to this is to use the DYNAMIC-FUNCTION syntax, which is rather clumsy for a model where you want the simplest possible coding style in your client logic.

So you want to be able to reference functions like widgetHandle directly in code in customersuper.p, even though the functions are no longer defined there. To do this without error, you must include function prototypes of all the support functions in your super procedure.

There is an OpenEdge tool to generate the prototypes for you, called ProtoGen. It is available from the PRO*Tools palette, as shown in Figure 1–5.

![Figure 1–5: ProTools palette](image)

In the Prototype Generator, you first enter the name of the super procedure it should generate prototypes for. In this case, it is the local version of src/adm2/custom/viewercustom.p. You then enter the name of the include file that the tool generates containing the prototype definitions. In the example it should be called viewcustomprto.i, as shown in Figure 1–6.

![Figure 1–6: Prototype Generator window](image)

Click Generate to create the include file.
In its default form, however, it is not exactly what you need. This is because the generator assumes that the include file will be added to an object procedure, such as the viewer procedure, so that functions in its super procedures can be referenced. For this reason, it creates function prototypes defined as being IN SUPER, meaning that the interpreter should invoke the function, and it will be found in a super procedure. For example:

```plaintext
FUNCTION widgetHandle RETURNS HANDLE
  (INPUT pcWidget AS CHARACTER) IN SUPER.
```

But in the present case, the function references are in another super procedure, viewercustom.p, which, as explained, is not a super procedure of customersuper.p. So the function prototypes must be modified to tell the interpreter to execute the function IN TARGET-PROCEDURE. When this happens, the interpreter searches up the stack and finds the function prototypes in another super procedure of the viewer, namely viewercustom.p, as shown:

```plaintext
/** Prototype include file: C:\ICFLocal\src\adm2\custom\viewcustomprto.i
 * Created from procedure: C:\ICFLocal\src\adm2\custom\viewercustom.p at 13:31
 * on 06/17/02
 * by the PROGRESS PRO*Tools Prototype Include File Generator
 */

FUNCTION disableWidget RETURNS LOGICAL
  (INPUT pcField AS CHARACTER) IN TARGET-PROCEDURE.
FUNCTION enableWidget RETURNS LOGICAL
  (INPUT pcField AS CHARACTER) IN TARGET-PROCEDURE.
FUNCTION highlightWidget RETURNS LOGICAL
  (INPUT pcField AS CHARACTER) IN TARGET-PROCEDURE.
FUNCTION setWidgetAttr RETURNS LOGICAL
  (INPUT pcField AS CHARACTER,
   INPUT pcAttr AS CHARACTER,
   INPUT pcValue AS CHARACTER) IN TARGET-PROCEDURE.
FUNCTION unhighlightWidget RETURNS LOGICAL
  (INPUT pcField AS CHARACTER) IN TARGET-PROCEDURE.
FUNCTION widgetHandle RETURNS HANDLE
  (INPUT pcWidget AS CHARACTER) IN TARGET-PROCEDURE.
FUNCTION widgetModified RETURNS LOGICAL
  (INPUT pcField AS CHARACTER) IN TARGET-PROCEDURE.
FUNCTION widgetValue RETURNS CHARACTER
  (INPUT pcField AS CHARACTER) IN TARGET-PROCEDURE.
```

**Note:** You can remove the prototype for the internal procedure displayFields, which is not needed. This is what the resulting include file should look like. The exact function prototypes depend on how many supporting functions you have in viewercustom.p.

Next, modify the Definitions section of your customersuper.p to include the prototype file, as shown:

```plaintext
{src/adm2/custom/viewcustomprto.i}
```

Now any references to the supporting functions in your custom super procedure will compile and execute successfully.
This entire exercise of moving commonly used code into a higher level in the super procedure stack illustrates a fourth principle to keep in mind whenever you are developing an application.

**Note:** Always factor out common code into the highest possible point in the super procedure stack.

A key aspect of Progress Dynamics as an application framework is that it provides a great deal of standard behavior that can be used in all objects of a given type. Whenever you develop code of your own, try to use it to extend that standard behavior whenever possible. In a sense this is just good normal programming practice, employing the concept of modular programming. However, ABL with its super procedures, published events, and object attributes provides a specific structure within which you can implement modular code. Whenever you write ABL code, always consider what general use it can be, and always take the time to remove commonly useful code and move it up to a higher level in the tree. When you do this, consider the range of objects that might want to take advantage of it. Does the code apply to just a subset of viewers, for example, so that it would be worthwhile to create a new specialized viewer class for just those objects? Or does it apply to all viewers? To all Datavis objects, which are visual objects that display database data? To all visual objects? To all client-side objects? This same set of questions can be asked about behavior you are adding to any part of the overall SmartObject class tree. Taking the time to write code that can then be reused by many other objects is an investment that will pay off many times over. The continuation of the viewer event example below is another illustration of this.

If you look at the UI event example, you will see that the supporting code needs further refinement. In the case of the `rowDisplay`, this is always called in the context of a single row’s display event, and putting code into `displayFields` to set and unset the local context (the values of `AllFieldNames` and `AllFieldHandles`) can safely be done there. But a UI event can occur on any event for any widget, so it is not as easy to encapsulate the context setting in such a general way.

The code for the example event procedure `CreditLimitLeave` must be modified to set and unset the context. Because this might be happening all over the place in your code, you should extract the code out into another pair of functions implemented in `viewercustom.p`, which you can call `setDisplayContext` and `clearDisplayContext`, as shown in the following examples:

```abl
FUNCTION setDisplayContext RETURNS LOGICAL
  (  ) :
  /*-------------------------------------------------------------------------
  Purpose:  Establish the list of fields and handles in the current viewer.
  Notes:                                           *
  *-------------------------------------------------------------------------*/
  {get AllFieldNames gcFields}.
  {get AllFieldHandles gcHandles}.
  RETURN TRUE.
END FUNCTION.
```
Now the `displayFields` procedure in `viewerCustom.p` can be cleaned up a little to use these two functions, as shown:

```
FUNCTION clearDisplayContext RETURNS LOGICAL
( ):
/*-------------------------------------------------------------------------*/
    Purpose: Clears any local storage of viewer context information.
    Notes:                                                                
-------------------------------------------------------------------------*/
    ASSIGN gcFields = "".
    gcHandles = "".
    RETURN TRUE.
END FUNCTION.

PROCEDURE displayFields:
/*-------------------------------------------------------------------------*/
    Purpose: Runs a `rowDisplay` procedure if there is one to allow
    custom logic to support any viewer.
    Parameters: `pcColValues` AS CHARACTER.
    Notes:                                                                
-------------------------------------------------------------------------*/
    DEFINE INPUT PARAMETER pcColValues AS CHARACTER NO-UNDO.
    RUN SUPER (INPUT pcColValues).
    DYNAMIC-FUNCTION ('setDisplayContext' IN TARGET-PROCEDURE).
    RUN rowDisplay IN TARGET-PROCEDURE NO-ERROR.
    clearDisplayContext().
END PROCEDURE.
```

So why does the reference to `setDisplayContext` have to execute IN TARGET-PROCEDURE (which in turn requires the use of the DYNAMIC-FUNCTION syntax, which allows you to specify where the function is invoked), even though the `setDisplayContext` function is implemented in the same source procedure as this version of `displayFields`? It is because of another aspect in the use of TARGET-PROCEDURE that it is important to go over.

In addition to using IN TARGET-PROCEDURE in code references that are written in the object the code supports, or that are written in another super procedure in the stack, it is important to remember to use IN TARGET-PROCEDURE even if the entry point your code is running is implemented in the super procedure itself, if the entry point makes another reference to the TARGET-PROCEDURE. This is because the TARGET-PROCEDURE reference in the called entry point only evaluates properly if it has bounced back from the base object itself. If the entry point is instead invoked directly in THIS-PROCEDURE (which is implicit if there is no qualifier on the RUN statement or function invocation), then within the called entry point, the value of TARGET-PROCEDURE is the same as THIS-PROCEDURE, since that is where the call originated.
Figure 1–7 illustrates the difference between the references.

In contrast, the `setDisplayContext` reference in the example uses the special `{get}` pseudo-syntax to retrieve the attribute values, and this includes the necessary reference to `TARGET-PROCEDURE` to point at the object where the attribute is defined, so any reference to the function must itself be made IN `TARGET-PROCEDURE` for things to resolve properly.
So with the function reference explicitly made IN TARGET-PROCEDURE, the function itself will be able to resolve it properly, as Figure 1–8 shows.

![Diagram](https://via.placeholder.com/150)

**Figure 1–8: Proper function reference with TARGET-PROCEDURE**

Now each event procedure sets and clears the context, so all references to the fields and handles within all invoked functions resolve properly without the attributes being retrieved each time, as shown:

```c
PROCEDURE CreditLimitLeave:
/*---------------------------------------------------------------*/
Purpose: Check the CreditLimit against the balance on LEAVE.
Parameters: <none>
---------------------------------------------------------------*/
setDisplayContext().
IF widgetModified('CreditLimit') THEN
   IF DECIMAL(widgetValue('CreditLimit')) -
      DECIMAL(widgetValue('Balance')) < 5000
      THEN highlightWidget('Balance').
   ELSE unhighlightWidget('Balance').
   clearDisplayContext().
END PROCEDURE.
```

To bring all this into sync:

1. Make the changes to the `viewercustom.p` procedure, save it, and compile it.
2. Regenerate the `viewcustomproto.i` prototype include file using the ProtoGen tool.
3. Edit the viewcustomprto.i file to change IN SUPER to IN TARGET-PROCEDURE.

4. Compile all the viewers that must use this support procedure. This includes any static viewers, such as custstviewv.w from the static example, as well as the generic dynamic viewer procedure rydynviewv.w.

As noted before, the formula for the credit limit check itself, which is duplicated in rowDisplay and CreditLimitLeave, should be removed to another function where it only must be defined once.

There is another way in which this example is simplified to the point where it does not actually set a good example: The formula that says that a customer balance within $5,000 of the credit limit represents a warning condition is really business logic, even though the way that condition is dealt with is simply to change something in the user interface. If that logic must be changed, or modified depending on the user organization or other conditions, then you have a maintenance headache to deal with because the code that expresses the condition is compiled into client user interface procedures and deployed to all the client systems.

It is much better to bring as much of the logic as possible over from the server at run time. At a minimum, this means that the $5,000 figure should be turned into an application property that is retrieved as needed, perhaps at startup along with a whole set of other client logic properties, in a single call to a business logic procedure running on the server. In that way, the logic that maintains that figure and determines what the proper figure is for this user or this organization can be maintained on the server along with other business logic.

**Running a PLIP from client logic**

A Progress Dynamics Persistent Library of Internal Procedures (PLIP) is simply an ABL procedure that is designed to hold business logic and run on the server side of a distributed application, to be invoked from other code either on the server or on the client side. Naturally, you want to avoid making calls from client code to the server whenever possible in order to maximize application performance. But sometimes it is necessary to make extra calls beyond those that the framework uses to populate the client-side objects and return data to the server. This section illustrates how you can use the Progress Dynamics Session Manager to invoke server-side logic that accesses the application database.

In this example, you want to allow the user to make a call back to the server to obtain the latest Credit information for a Customer during OrderLine maintenance. Again, whenever possible, this kind of information should always be brought over along with other information the framework objects are already handling for you, using a device such as calculated fields in an SDO. But for the sake of the example, we presume that this must indeed be an immediate call back to the server.
To run a Progress Dynamics PLIP:

1. Build the business logic procedure itself. Click **New** in the AppBuilder, and select **Structured PLIP** as the object type. See *OpenEdge Development: Progress Dynamics Basic Development* for more information on the structure of the PLIP. In the **Section Editor**, add a new internal procedure called **AvailCredit**, which looks like this:

```plaintext
PROCEDURE AvailCredit:
/*---------------------------------------------------------------------
Purpose:          
Parameters: <none>        
Notes:            */
DEFINE INPUT PARAMETER pcKeyType AS CHARACTER NO-UNDO.
DEFINE INPUT PARAMETER piKeyNum AS INTEGER NO-UNDO.
DEFINE OUTPUT PARAMETER pdAvailCredit AS DECIMAL NO-UNDO INIT ?.
IF pcKeyType = "OrderNum" THEN
  DO:
    FIND Order WHERE Order.OrderNum = piKeyNum NO-LOCK NO-ERROR.
    IF AVAILABLE (Order) THEN
      FIND Customer WHERE Customer.CustNum = Order.CustNum NO-LOCK.
      END.
  ELSE IF pcKeyType = "CustNum" THEN
    FIND Customer WHERE Customer.CustNum = piKeyNum NO-LOCK NO-ERROR.
    IF AVAILABLE (Customer) THEN
      pdAvailCredit = Customer.CreditLimit.
      END.
  END.
END PROCEDURE.
```

This takes a `pcKeyType` parameter to tell it whether the key being passed in is a `CustNum` or an `OrderNum`, and then uses the key value itself to retrieve the appropriate `Customer` record. It returns `Customer.CreditLimit` as the output parameter. Again, real-life PLIPs will normally do more serious work that could not be returned in a simple field as part of an SDO.

2. Save this PLIP in the `oe` directory (or wherever you are organizing your objects) as `customerplip.p`.

Now you must build a window where you support `Order` and `OrderLine` maintenance. Any combination of objects that manages these tables will do, but the step describes the combination used for the present example. The example presumes that you have generated SDOs and dynamic viewers and browsers for the Sports2000 tables.

3. Build an `Order` browse window as an independent window. (For more information on building a browse window, see *OpenEdge Development: Progress Dynamics Basic Development.*) Use the layout called `rywinObjCont` as the **Container Template**, substitute the SDO `orderfullo` for the template SDO, and substitute the dynamic browser `orderfullb` for the template browser. Select the dynamic browser in the layout grid, right-click to bring up the property sheet, and type `orderfoldwin` as the **FolderWindowToLaunch** property.
Writing Super Procedures for Objects

This is the maintenance window that starts when the user double-clicks on a row in the browse or selects one of the update-related buttons in the toolbar:

4. Save this container as `orderbrowsewin`.

5. Create the Order Maintenance window. Create a new dependent window, which gets the `OrderNum` as input from the Order browse window. Use the folder window `rywinFolder` as the existing container to create this from.

6. Select Page 1 in the Container Builder, which is part of the container template. This page layout is designed for a single static viewer. If you have a dynamic Order viewer you would like to use instead, you can unsubstitute the page layout `rypagDynView` as the template. Substitute the Order viewer (the example static viewer is `ordersview.w`, previously built in the AppBuilder) for the template viewer.

7. Add a Page 2 to display and maintain `OrderLine` records. Add the dynamic `OrderLine` SDO `orderlinfulllo` to this page, along with the dynamic browser `orderlinfullb`, and the dynamic viewer `orderlinviewv`.

8. Select the `orderlinfulllo` SDO in the grid, open the property sheet for it, and type `ordernum,ordernum` as the Foreign Fields. This will filter the `OrderLine` SDO for `OrderLine` records of the currently selected Order.

9. Fill out the necessary data and update links between the `OrderLine` objects on Page 2 so that records are passed back and forth properly.

10. Create a `TableIO` link from the StandardToolBar to the static Order viewer `ordersview`. This allows the toolbar on Page 0 to maintain the Order displayed on Page 1. Create another `TableIO` link from it to the `OrderLine` viewer `orderlinviewv` as well.

11. Create a `Data` link from THIS-0BJECT (which represents the container itself) to the static Order viewer. This populates the viewer with data from the record selected in the browse window.

12. Create an `Update` link from the static Order viewer to THIS-0BJECT. This will pass the update back to the Order SDO maintained in the browse window.
13. Create a Data link from THIS-OBJECT to the OrderLine SDO orderlinfullo. This will pass the current OrderNum in to the OrderLine SDO, which, using the Foreign Fields information you entered, will filter the OrderLine records for the current Order.

When you are done, your **Links Maintenance** window should look like this:

![Links Maintenance window](image)

14. Save this as **orderfoldwin**.

15. Add a fill-in to the dynamic OrderLine viewer. Open the **orderlinviewv** viewer in the AppBuilder using the **Open Object** dialog box. Add the fill-in to the layout just as you would for a static viewer. Name it **AvailCredit** and give it a label of **Available Credit** and a format of >>>>9.99.

16. Define a UI event for this new field using the dynamic property sheet from the AppBuilder to trigger the internal procedure inside the custom super procedure that will, in turn, execute the server-side code to retrieve the credit information.

   It might be a better user interface if there was a button for the user to press to retrieve the credit information, but to keep things simple, retrieve the information **ON LEAVE** of the dynamic fill-in itself by continuing the procedure.

17. Type an **Event Name** of **LEAVE**, type an **Action Type** of **RUN**, type an **Action Target** of **SELF**, and for the **Event Action** type the internal procedure name **ShowAvailCredit**. This defines a UI event that, **ON LEAVE** of the dynamic fill-in, will run the procedure **ShowAvailCredit** in the **TARGET-PROCEDURE**.

18. Save this new UI event.
19. Create the custom super procedure for the OrderLine viewer by selecting **New → Structured Procedure** in the AppBuilder. Use the **Section Editor** to create an internal procedure called ShowAvailCredit. This procedure first retrieves the lists of field names and field handles from its `TARGET-PROCEDURE`, as the earlier example did, as shown:

```
{get AllFieldNames cFieldNames}.
{get AllFieldHandles cFieldHandles}.
```

The next block of code illustrates how you can retrieve values not only from fields in the viewer, but from any other related object in the container. Because the **Customer Number** is the preferred key value to use to retrieve the **Credit Limit**, but that field is not normally displayed in an OrderLine viewer, the code attempts to locate an Order SDO with the customer number in it. So it retrieves first the data source of the current viewer, which is the OrderLine SDO, and then its data source, which should be the Order SDO if there is one, as shown:

```
hDataSource = DYNAMIC-FUNCTION('getDataSource':U IN TARGET-PROCEDURE).
hDataSource = DYNAMIC-FUNCTION('getDataSource':U IN hDataSource).
```

Note that these two statements are effectively identical to this `{get}` include file syntax, as shown:

```
{get DataSource hDataSource}.
{get DataSource hDataSource hDataSource}.
```

This version might look confusing because the handle is reused to retrieve the second data source from the first. The second statement amounts to this:

- Get the value of the DataSource attribute and put it into the variable `hDataSource`. Use `hDataSource` itself as the handle of the object to query for its DataSource.
- If this optional third argument to the `{get}` include file is not there, it uses the `TARGET-PROCEDURE` by default.

In some cases there is no Order SDO above the OrderLine SDO. Because you should always write code that is as general-purpose as possible, it is good to allow for any combination of objects in any custom code you write. So the block of code checks to see whether this second DataSource in fact returned a valid procedure handle. If it did, then it uses an SDO function to retrieve the value of the **CustNum** field for the current row, as shown:

```
iKeyNum = INTEGER(DYNAMIC-FUNCTION
    ('columnStringValue':U IN hDataSource, "CustNum":U)).
```
It sets another variable to indicate that it retrieved the CustNum. But if that second handle is not valid, then the code tries another approach, instead retrieving the value of the Order Number field from the OrderLine viewer, using the field names and handles lists, as shown in the following example:

```
ASSIGN ilookup = LOOKUP("OrderNum", cFieldNames)
    hField = WIDGET-HANDLE(ENTRY(ilookup, cFieldHandles))
    iKeyNum = INTEGER(hField:SCREEN-VALUE)
```

It sets the other variable to indicate that what it retrieved is the OrderNum.

Save this procedure and register it in the Repository. Then associate it with the dynamic OrderLine viewer in the AppBuilder. To do this, open the OrderLine viewer, double-click on it to bring up its App Builder property sheet, and set the Custom ADD-SUPER-PROC field to orderlinsuper.p. Note that you do not specify the .p filename extension or the relative pathname because this information was placed in the Repository when you registered the procedure.

This simplified example might seem a bit contrived, but it demonstrates a couple of basic principles that are important to keep in mind when you write this kind of code:

- **Always write your code to work in as many client object configurations as possible** — Do not assume a particular combination of objects in the client container, and do not assume what the exact contents of those objects will be. This makes your code more flexible and reusable, and less prone to errors if other objects in the user interface change.

- **Retrieve information from other objects if you need to** — Remember that you can get data from anywhere else on the client, as long as you are flexible about how you look for it. The link functions in each SmartObject will connect you to other objects, and various types of functions can retrieve information from those objects. Getting the object’s ContainerSource and then searching the container’s ContainerTargets can allow you to locate any other object in the same container window as the object you started from. If a search such as this saves you from an extra AppServer hit to retrieve data that might be elsewhere on the client, it is well worth it.

### Using launch.i or dynlaunch.i to run the PLIP

Next comes the key part of the exercise: running the business logic procedure that is located where the data is, which will return the needed Credit value. The standard Progress Dynamics include file, launch.i, takes a series of named arguments that is explained in OpenEdge Development: Progress Dynamics Basic Development. In this example, it runs the internal procedure AvailCredit in the persistent procedure customerplip.p, passing it the parameter list specified, deleting the running instance of customerplip.p when it is done, as shown:

```
{launch.i &PLIP = 'oe/customerplip.p'
    &IProc = 'AvailCredit'
    &PList = "(INPUT cKeyType, INPUT iKeyNum, OUTPUT dAvailCredit)"
    &AutoKill = YES
    &Perm = NO}
```
There is now a new alternative to launch.i that is more efficient in cases where you do not need to retain the procedure handle of the business logic procedure after your request has returned. This include file is dynlaunch.i, and it takes advantage of the dynamic CALL object to carry out the entire request in a single AppServer call, running code on the server that starts the PLIP if it is not already running, runs the requested internal procedure, passes in any INPUT parameters, receives back any OUTPUT parameters, and deletes the PLIP if it was started by the call.

The dynlaunch.i file uses essentially the same named arguments as launch.i, except that INPUT and OUTPUT parameters are expressed as named arguments rather than as a single quoted string. This is because the arguments are actually evaluated on the server dynamically using a CALL object to construct the call at run time. For each parameter to the internal procedure you are running, you must specify three named include file arguments. In each case, \( n \) represents the position of the parameter in the calling sequence:

- **Mode** \( n \) — INPUT, OUTPUT, or INPUT-OUTPUT.
- **&Parm** \( n \) — The parameter name as a single-quoted string.
- **&DataType** \( n \) — The data type of the parameter as an unquoted string.

Also, because the handle of the server-side procedure cannot be made available to the client after the call is complete, the &AutoKill and &Perm arguments do not apply. A call to dynlaunch.i to accomplish the same request as the previous call to launch.i looks like this:

```
{dynlaunch.i &PLIP = 'oe/customerplip.p'
 &IProc = 'AvailCredit'
 &mode1 = INPUT   &parm1=cKeyType &dataType1 = CHARACTER
 &mode2 = INPUT   &parm2=iKeyNum &dataType2 = INTEGER
 &mode3 = OUTPUT  &parm3=dAvailCredit &dataType3 = DECIMAL
}
```

If you use dynlaunch.i, you must also include this reference in the definitions section of your procedure so that the variables it uses are properly defined, as shown:

```
{dynlaunch.i &define-only=YES}
```

Next comes the standard error checking include file, checkerr.i, which is described in OpenEdge Development: Progress Dynamics Basic Development, as shown:

```
{checkerr.i &display-error = YES
 &return-only = YES}
```

These arguments mean that an error will be displayed if there is one (because the code is being executed on the client, where the error dialog box can be displayed). The code will return out of the procedure if there is an error, but will not pass a specific error condition to its caller.
Running a PLIP from client logic

The code locates the dynamic fill-in AvailCredit in the viewer, and sets its SCREEN-VALUE, as shown:

```plaintext
ASSIGN ilookup = LOOKUP("AvailCredit", cFieldNames)
    hField = WIDGET-HANDLE(ENTRY(ilookup, cFieldHandles))
    hField:SCREEN-VALUE = STRING(dAvailCredit).
```

Testing the completed business logic procedure

The following code sample is the complete business logic procedure:

```plaintext
PROCEDURE ShowAvailCredit:
/*-------------------------------------------------------------------------
 Purpose: Retrieves the Credit Limit from the server and displays it viewer.
-------------------------------------------------------------------------*/
DEFINE VARIABLE hDataSource AS HANDLE NO-UNDO.
DEFINE VARIABLE cFieldNames AS CHARACTER NO-UNDO.
DEFINE VARIABLE cFieldHandles AS CHARACTER NO-UNDO.
DEFINE VARIABLE ilookup AS INTEGER NO-UNDO.
DEFINE VARIABLE hField AS HANDLE NO-UNDO.
DEFINE VARIABLE iKeyNum AS INTEGER NO-UNDO.
DEFINE VARIABLE cKeyType AS CHARACTER NO-UNDO.
DEFINE VARIABLE dAvailCredit AS DECIMAL NO-UNDO.
{get AllFieldNames   cFieldNames}.
{get AllFieldHandles cFieldHandles}.
hDataSource = DYNAMIC-FUNCTION('getDataSource':U IN TARGET-PROCEDURE).
hDataSource = DYNAMIC-FUNCTION('getDataSource':U IN hDataSource).
IF VALID-HANDLE (hDataSource) THEN
    ASSIGN cKeyType = "CustNum"
    iKeyNum = INTEGER(DYNAMIC-FUNCTION
        ('columnStringValue':U IN hDataSource, "CustNum":U)).
    ELSE
    ASSIGN ilookup = LOOKUP("OrderNum", cFieldNames)
        hField = WIDGET-HANDLE(ENTRY(ilookup, cFieldHandles))
        iKeyNum = INTEGER(hField:SCREEN-VALUE)
        cKeyType = "OrderNum".
    {dynlaunch.i &PLIP = 'oe/customerplip.p'
        &IProc = 'AvailCredit'
        &mode1 = INPUT   &parm1='cKeyType'     &dataType1 = CHARACTER
        &mode2 = INPUT   &parm2='iKeyNum'      &dataType2 = INTEGER
        &mode3 = OUTPUT  &parm3='dAvailCredit' &dataType3 = DECIMAL
    }
    {checkerr.i &display-error = YES &return-only = YES}
    ASSIGN ilookup = LOOKUP("AvailCredit", cFieldNames)
        hField = WIDGET-HANDLE(ENTRY(ilookup, cFieldHandles))
        hField:SCREEN-VALUE = STRING(dAvailCredit).
END PROCEDURE.
```
To try out the finished application window:

1. Launch **orderbrowsewin** and select an order:

![Image of orderbrowsewin](image1)

2. Double-click on the order to bring up **orderbyprin**:

![Image of orderbyprin](image2)

Remember that some of the links you defined in the Container Builder set up a connection from the browse window to the maintenance window. These are the links that have **THIS-OBJECT** (the maintenance window) as the source for the link. These pass-through links allow the order data to be retrieved and displayed by the Order viewer on Page 1, and also allow the OrderLine SDO on Page 2 to retrieve the OrderNum to use for filtering its own query.
3. Select Page 2. Then select the Available Credit field you created and tab out of it. The Leave trigger fires, which runs showAvailCredit in the viewer’s custom super procedure orderlinsuper.p. This, in turn, runs AvailCredit in the customerplip.p procedure, which returns the Customer.CreditLimit for display:

Building a custom super procedure for a browser

Any Progress Dynamics object can have a custom super procedure, not just a viewer. To illustrate this, you can build one for a dynamic browser to do the same thing the first viewer example did: to highlight a browse cell if the balance is within $5,000 of the credit limit.

Remember that there are only limited visual modifications that can be made to an individual browse cell on display of a particular row, including changing the background color, the font, or the format of the data. So for your purposes, the highlight action works well, since it changes the background color.

You can move some of the same code from the viewer example to a custom super procedure for a browser. To the extent that the same actions apply, this code could be factored out all the way up to the level of the datavis or even the visual class, but you do not go that far in this example.

To build the example, create a new structured procedure called custbsuper.p. First, it needs a local version of initializeObject. Like the first version of the viewer super procedure, this code assumes that it is serving only a single browser instance, so initializeObject stores attribute values locally for other functions to use. The code sets the ScrollRemote attribute in the browser to TRUE. This attribute causes the browser to define the internal procedure rowDisplay as a trigger procedure for the browser’s ROW-DISPLAY ABL event, which occurs each time a row of data is displayed to the browse widget. This event gives you the opportunity to intercept the display, check data values, and make limited changes (as noted above) to the cells in the browse.
This section contains information on custom super procedures for browsers, including:

- **Useful browser properties.**
- **Coding the rowDisplay procedure.**
- **Creating the other support functions.**
- **Defining the custom super procedure for a browser.**
- **Changing browser attributes for the master and instance.**

### Useful browser properties

The code runs the standard `initializeObject` behavior and then captures three property values locally:

- The `DisplayedFields` property holds a comma-separated list of all the column names in the browse. Since you are only interested (for the purposes of this example at least) in looking at values in the browse itself, this is all you need. Note that the `AllFieldNames` and `AllFieldHandles` properties are defined for the browser, as they are for viewers, but they hold only the name and handle of the browse widget itself, along with any additional fields or other widgets that you might add to the browser’s frame, not the names and handles of the browse columns themselves. So they are not useful for your purposes here.

- The `FieldHandles` property holds a comma-separated list of the widget handles of the browse cells, in the same order as the `DisplayedFields` list.

- The `QueryRowObject` property holds the handle of the record buffer for the `RowObject` table in the SDO that is used to populate the browse. This is needed because, within the `ROW-DISPLAY` event trigger where the custom code executes, it is not possible to inspect the `SCREEN-VALUES` of the cells themselves, so the `widgetValue` function looks at the corresponding `RowObject` fields instead, as shown:

```plaintext
PROCEDURE initializeObject
/*-----------------------------------------------------
Purpose:     ScrollRemote enables the rowDisplay trigger on the browse's
            ROW-DISPLAY event, used to customize cell color etc.
Parameters:  <none>
Notes:       
*/
DYNAMIC-FUNCTION("setScrollRemote" IN TARGET-PROCEDURE, TRUE).

RUN SUPER.
{get DisplayedFields gcFields}.
{get FieldHandles gcHandles}.
{get QueryRowObject ghBuffer}.
END PROCEDURE.
```
Building a custom super procedure for a browser

The variables gcFields, gcHandles, and ghBuffer must be defined in the Definitions section of the procedure, so that they are scoped to the procedure as a whole, as shown:

```plaintext
DEFINE VARIABLE gcFields  AS CHARACTER  NO-UNDO.
DEFINE VARIABLE gcHandles AS CHARACTER  NO-UNDO.
DEFINE VARIABLE ghBuffer  AS HANDLE     NO-UNDO.
```

Coding the rowDisplay procedure

Next, you must code the rowDisplay procedure where your custom logic is written. This corresponds to the rowDisplay procedure in the viewer custom super procedure. The name of this procedure is significant because, as described earlier, the standard browser code automatically defines this internal procedure as the event procedure for the ROW-DISPLAY event when the ScrollRemote property is set on.

There is a small amount of standard browser code for rowDisplay, so it must first RUN SUPER. Then it can contain exactly the same statements as a corresponding viewer. You will create equivalent support functions to make this work properly, as shown:

```plaintext
PROCEDURE rowDisplay:
/*-------------------------------------------------------------------------
 Purpose:    This procedure holds any custom client-side display logic for the Browser.
 Parameters: <none>
 Notes:                              */

RUN SUPER.

IF DECIMAL (widgetValue('CreditLimit')) - DECIMAL (widgetValue('Balance')) LT 5000 THEN
    highlightWidget('Balance').
END PROCEDURE.
```

Creating the other support functions

Now create the support functions to make this work. The widgetHandle function can be the same as in the viewer example, because it uses the same gcFields and gcHandles variables, even though those are derived from different object properties.
The \texttt{widgetValue} function, however, looks a little different because, as noted, you cannot reference the cell values of the browse cells from within the \texttt{ROW-DISPLAY} event. For this reason the code refers back to the SDO’s \texttt{RowObject} record buffer, captured from the \texttt{QueryRowObject} property, to get the field value from there, as shown:

\begin{verbatim}
FUNCTION widgetValue RETURNS CHARACTER
( pcColumn AS CHARACTER ) :
    /*-------------------------------------------------------------------------
    Purpose: Returns the value of the requested browse column
             from the RowObject buffer.
    Params:  INPUT pcColumn AS CHARACTER
    Notes:     */
    DEFINE VARIABLE hField AS HANDLE NO-UNDO.
    hField = ghBuffer:BUFFER-FIELD(pcColumn).
    RETURN STRING(hField:BUFFER-VALUE).
END FUNCTION.
\end{verbatim}

The \texttt{highlightWidget} function, like any other functions that just use \texttt{widgetHandle} and \texttt{widgetValue}, can be the same code as for the viewer example.

\textbf{Defining the custom super procedure for a browser}

You can associate a procedure as a super procedure for a browser.

\begin{itemize}
\item To make this new procedure a custom super procedure for a \texttt{Customer} browser:
\item 1. In the AppBuilder, use the \textbf{Open Object} dialog box to open the property sheet for the browser:
\item 2. Set the custom super procedure in the AppBuilder’s property sheet for the browser.
\end{itemize}
Changing browser attributes for the master and instance

To see the Credit Limit and Balance columns more easily, rearrange the column order in the Selected Fields list to move them to the front of the column list.

Now launch your dynamic window containing the Customer browser to see the effect of your custom super procedure logic:

Using the client logic API

The client logic API is a collection of functions (extending the visual class) and a programming standard that support easier development of client-side user interface logic in containers, browsers, viewers, and other visual objects.

The client logic API essentially supports widget manipulation in containers, browsers, viewers, and visual objects in both static and dynamic objects. For example, you might want to enable some fields in a dynamic viewer based upon the value of another field. The API, in particular, makes it much easier to associate code with one browse or viewer and have that code manipulate widgets in a different browse or viewer (as long as both are in the same container).

You can use the client logic API in static object code or in custom super procedures for dynamic objects.

You must write client logic for each rendering engine separately. An application for both the GUI and DHTML clients must maintain two versions of client logic, one written in ABL for GUI rendering and another written in JavaScript for Web rendering. See OpenEdge Development: Progress Dynamics Web Development Guide for information on DHTML client development.
Basic rules

The API uses **widget** to identify an object that can be accessed or modified using the API. These objects include any object with a widget handle in the AVM environment, plus SmartDataFields (which use the procedure handle).

**Note:** The client logic API does not support toolbar button manipulation.

The functions of the client logic API are, for the most part, intended for use in comparisons and assignments. For example:

```plaintext
IF widgetIsModified("customerviewv.discount":U) THEN
    enableWidget("customerviewv.terms":U).
    tempDiscount = INTEGER(widgetValue("discount":U)) * 1.10.
```

Restricting your use of the API to comparisons and assigns will assure you of the best results for migrations to future versions of Progress Dynamics.

Logic

The client logic API supports code written in the following locations:

- Static object code.
- Custom super procedure logic associated with containers, browses, and viewers.

For dynamic objects, while you can use the API in any function or internal procedure of the custom super procedure, the following are usually the best places to put client logic code:

- **rowDisplay** internal procedures.
- Widget event procedures.
- ADM override procedures and functions.

**Note:** You cannot use the client logic API in the main block of the custom super procedure.

**rowDisplay internal procedures**

For your custom super procedures, take advantage of this procedure and place appropriate client logic code inside. This technique is parallel to the validation procedures of the SDO, in that it provides a hook where you can put code and benefit from the supplied standard behavior.

Unless noted in the description of the function, the API only supports actions within a browse **rowDisplay** internal procedure that are supported by ABL for the browse **ROW-DISPLAY** event.
Widget event procedures

The standard name for UI event procedures is `<widget><event>`. For example, CreditLimitLeave, indicates ON LEAVE OF CreditLimit.

The Migration utility converts existing embedded trigger code blocks into super procedure internal procedures with this naming convention, so this is the recommended standard for new UI event procedures (the event action).

Note that you must first define your own UI events using the dynamic property sheet.

ADM overrides

Use the API in ADM overrides as you would use any of the APIs described in the ADM documentation. See the ADM documentation for more information about overrides.

Error handling

The client API does not raise errors, since errors at the client level are not desirable. If Progress Dynamics cannot locate a referenced object, or if it does not support the specified operation, then the function returns FALSE or the Unknown value (?) if the function has a character or handle return. Progress Dynamics raises no other visible error condition.

TARGET-PROCEDURE

When using the client API from a super procedure, always remember to invoke internal procedures and functions IN TARGET-PROCEDURE from a super procedure.

Object qualification

In the API signatures, name is the widget name or SmartDataField name of the object you want to manipulate. In some methods, you can supply a namelist, which is a CHARACTER string of one or more widget or SmartDataField names. Separate multiple names with commas without intervening spaces.

Client logic code on the GUI client supports both qualified and unqualified names, as described in the next sections.

Unqualified names

When you supply just the widget names, these are considered unqualified names. The APIs have the ability to resolve unqualified names where there is no ambiguity. Using unqualified names speeds code writing and promotes reuse of code. For example, you can move code with unqualified names from one object to a similar object without changing it.

In the GUI client, unqualified widgets are qualified by a search algorithm based on where the code containing the unqualified reference is written.
The following table describes how each type of object finds objects with unqualified instance names:

<table>
<thead>
<tr>
<th>Object type</th>
<th>Qualification method</th>
<th>Unqualified examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Container</td>
<td>Does not support unqualified names.</td>
<td>NA</td>
</tr>
<tr>
<td>Browse</td>
<td>Checks for object in the browse first. Then checks for widgets (data fields only) in viewers with the same data source, using the first widget found.</td>
<td>ordernum orderdate</td>
</tr>
<tr>
<td>Viewer</td>
<td>Checks for a widget in that object first (data fields and local fields). Then checks for widgets (data fields only) in sibling viewers (viewers linked to the viewers data source). Progress Dynamics uses the first widget found.</td>
<td>orderfullo.ordernum orderlinefullo.ordernum</td>
</tr>
</tbody>
</table>

The search algorithm is complicated a bit by references to SBO fields. Suppose a viewer displays fields from an SBO that draws data from several SDOs. To fully qualify which data source (SDO) fields are sources for viewer fields, the field is qualified by the SDO name: $SDOname.fieldname$. For example, $orderfullo.ordernum$ and $orderlinefullo.ordernum$.

So, to deal effectively with this use case, first, the API treats names with a single qualifier as a field name qualified with an SDO name. If it fails to find the named widget, it then treats the first qualifier as an SDO name qualifier.

In an SBO-based viewer, an unqualified widget name will find a local widget with a matching name before looking in the SBO for a qualified field. The search to locate the widget in data-source siblings is done after checking whether the unqualified field matches an SBO field. The unqualified search will return a handle even if the request is ambiguous and more than one field matches the unqualified name, so the qualifier should be used to guarantee precision. The qualified search is also faster.
Qualified names

Use qualified names when writing complex code or when the rules for resolving unqualified names does not meet the needs of your application.

Object names can be qualified by one of several methods. They are searched depending upon the location of the client logic. If the first entry in a list of objects is qualified and others in the list are not, the first qualifier extends as a default to other unqualified items in the list. Table 1–1 lists the various uses of qualification.

<table>
<thead>
<tr>
<th>Qualification</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>With the Self keyword.</td>
<td>For a browse or viewer, Progress Dynamics checks for a widget (data fields and local fields) in that object only. It uses everything after self as the field name. In the second example, orderfullo.orderdate is the field name. For a container, there is no support for the self qualifier.</td>
<td>Self.custnum&lt;br&gt;Self.orderfullo.orderdate</td>
</tr>
<tr>
<td>With the Browse keyword.</td>
<td>For a browse, Progress Dynamics checks for a widget in that object only. For a viewer, Progress Dynamics gets the viewer’s data source and checks for a widget in its browse data target. For a container, there is no support for the browse qualifier. Browse is an allowed ABL variable. You cannot use a widget name of “Browse” with the client logic API.</td>
<td>Browse.contact&lt;br&gt;Browse.empnum</td>
</tr>
<tr>
<td>With an SDO name and Browse keyword.</td>
<td>For a browse or viewer, Progress Dynamics finds the SDO in the object’s container source and checks for a widget in the SDO’s browse data target. For a container, Progress Dynamics checks for a widget in the SDO’s browse data target.</td>
<td>benefitsfullo.&lt;br&gt;Browse.empnum&lt;br&gt;customerfullo.&lt;br&gt;Browse.name</td>
</tr>
<tr>
<td>With an SDO name.</td>
<td>For a browse or viewer, Progress Dynamics finds the SDO in the object’s container source and checks for a widget in the SDO’s data targets, but checks the update source first. The first widget found is used. For a container, Progress Dynamics checks for a widget in the SDO’s data targets but checks the update source first. Progress Dynamics uses the first widget found.</td>
<td>salesreppullo.&lt;br&gt;region&lt;br&gt;customerfullo.&lt;br&gt;discount</td>
</tr>
<tr>
<td>With an SBO name and Browse keyword.</td>
<td>Any use of a field name from an SBO must be qualified with an SDO name: $SBOname.$SDOnname.$fieldname. In a browse or viewer, Progress Dynamics finds the SBO in the object container source and checks for a widget SBO’s browse data target. In a container, Progress Dynamics checks for a widget in the SBO’s browse data target.</td>
<td>ordersbo.Browse.&lt;br&gt;orderfullo.&lt;br&gt;orderdate&lt;br&gt;employeesbo.&lt;br&gt;Browse.&lt;br&gt;employeefullo.name</td>
</tr>
</tbody>
</table>
**Table 1–1: Qualifying names**

<table>
<thead>
<tr>
<th>Qualification</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>With an SBO name.</td>
<td>Any use of a field name from an SBO must be first qualified with an SDO name: <code>SBOname.SDOname.fieldname</code>.</td>
<td><code>ordersbo.itemfullo.itemnum</code> <code>employeesbo.benefitsfullo.ext</code></td>
</tr>
<tr>
<td></td>
<td>If the viewer qualifies the fields with an SDO name (because they have been defined for an SBO), Progress Dynamics uses the SDO name in the search, otherwise it uses only the field name.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>In a browser or viewer, Progress Dynamics finds the SBO in the object container source and checks for a widget in the SBO’s data targets that map to the SDO, but checks the update source first. The first widget found is used.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>In a container, Progress Dynamics checks for a widget in the SBO’s data targets that map to the SDO, but checks the update source first. The first widget found is used.</td>
<td></td>
</tr>
</tbody>
</table>

**Client logic functions**

Table 1–2 summarizes the functions and procedures that make up the client API. For complete information, see *OpenEdge Development: ADM Reference*.

**Table 1–2: Client logic functions**

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>assignFocusedWidget</td>
<td>Sets focus to the named object. Not supported for SmartDataFields and returns FALSE if attempted for SmartDataFields.</td>
</tr>
<tr>
<td>assignWidgetValue</td>
<td>Takes the name of one object and a character screen value as input and sets the SCREEN-VALUE of the object. The DataValue is set for a SmartDataField. (This would always be the key field for a lookup even where the display field is different.) This function sets DataModified to make the toolbar enable saving data (it behaves as if the user actually changed the field value manually). DataModified is set to TRUE whether or not the field is enabled.</td>
</tr>
<tr>
<td>assignWidgetValueList</td>
<td>Takes the name of one or more objects and character screen values and a delimiter as input and sets the SCREEN-VALUE of the objects. The DataValue is set for a SmartDataField (this would always be the key field for a lookup even where the display field is different). This function sets the DataModified attribute to force the toolbar to enable saving data (it behaves as if the user actually changed the field value manually). The DataModified attribute is set to TRUE whether the field is enabled or not.</td>
</tr>
</tbody>
</table>
Blank the SCREEN-VALUE of the objects in the namelist. The DataValue is blanked for a SmartDataField (this would always be the key field for a lookup even where the display field is different).

This function sets the DataModified attribute to force the toolbar to enable saving data (it behaves as if the user actually changed the field value manually).

This does nothing to objects that do not support SCREEN-VALUE and to objects where a blank screen value does not make sense, such as toggle boxes. It blanks a combo box by setting its list items to null.

Clear any value currently in the widget. Currently, if a save is attempted on a widget before a new value is provided, the widget will revert to its last saved value.

Disables the specified radio button of the radio set objects identified in the namelist. Returns FALSE if a widget in the list is not a radio set, if a widget in the list is not found, or if the button number is invalid.

Disables the objects identified in the namelist.

For SmartDataFields, it runs the disableField function. Note that disableField is not a generic SmartDataField function, therefore this API is only supported for SmartDataFields that have disableField defined. If a field in the list is not found or a SmartDataField without disableField is included in the list, disableWidget returns FALSE.

Enables the specified radio button of the radio set objects identified in the name list. Returns FALSE if a widget in the list is not a radio set, if a widget in the list is not found, or if the button number is invalid.

Enables the objects identified in the name list. For SmartDataFields, it runs the enableField function. Note that enableField is not a generic SmartDataField function, therefore this API is only supported for SmartDataFields that have enableField defined. If a field in the list is not found or a SmartDataField without enableField is included in the list, enableWidget returns FALSE.

Returns the SCREEN-VALUE of the object, or in the case of a browse column when in a ROW-DISPLAY trigger, the STRING-VALUE from the RowObject buffer field. The DataValue is returned for a SmartDataField (this would always be the key field for a lookup even where the display field is different). For example, you could use this function to get the formatted value of a single field to use for comparisons.
Table 1–2:  Client logic functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>formattedWidgetValueList</td>
<td>Takes the name of one or more objects and returns the SCREEN-VALUE of the object or objects. For example, use this function to retrieve the formatted values of several fields to assign their screen values to other fields. If the object is a browse column (called from within a ROW-DISPLAY trigger), the STRING-VALUE from the RowObject buffer field is added to the list of returned values. If the object is a SmartDataField, the DataValue field is returned. The DataValue field is always the key field, even when the display field is different. If a field in the list is not found or a field has an Unknown value (?), the function returns “?” for its value in the returned character list.</td>
</tr>
<tr>
<td>hideWidget</td>
<td>Hides the objects identified in the namelist (and their pop-up buttons). For SmartDataFields, it invokes the hideObject method.</td>
</tr>
<tr>
<td>highlightWidget</td>
<td>Sets the background and foreground colors (FGCOLOR and BGColor widget attributes) of the named objects to a standard highlight color, depending on the value of the highlightType argument. For example, you might want to change the background color of a field with an invalid value to red.</td>
</tr>
<tr>
<td>resetWidgetValue</td>
<td>Resets the SCREEN-VALUE of the objects identified in the name list back to its original value from its data source. If a field in the list is not found or there is no data source for a field in the list, FALSE is returned and it will process all others in the list.</td>
</tr>
<tr>
<td>toggleWidget</td>
<td>Reverses the value of one or more objects of type LOGICAL in the name list. The format of the widget is used to reverse its SCREEN-VALUE. For example, a logical with a format of credit/debit would change a “credit” screen-value to “debit.” A null value is not changed and FALSE is returned. This function sets the DataModified attribute to force the toolbar to enable saving data (it behaves as if the user actually changed the field value manually).</td>
</tr>
<tr>
<td>viewWidget</td>
<td>Views the object or objects identified in the namelist (and their pop-up buttons). For SmartDataFields, it invokes the viewObject method.</td>
</tr>
<tr>
<td>widgetHandle</td>
<td>Returns the handle of the requested object. For a basic object it returns the WIDGET-HANDLE. For a SmartDataField it returns the procedure handle.</td>
</tr>
<tr>
<td>widgetIsBlank</td>
<td>Returns TRUE if the widget is blank, otherwise FALSE. If the namelist contains more than one object, then the function returns TRUE if all of them are blank, otherwise FALSE.</td>
</tr>
<tr>
<td>widgetIsFocused</td>
<td>Returns TRUE if the widget has focus. This is not supported for SmartDataFields. This returns the Unknown value (?) if the field is not found or if the widget is a SmartDataField.</td>
</tr>
</tbody>
</table>
Using the client logic API

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>widgetIsModified</td>
<td>Returns TRUE if the MODIFIED attribute or its equivalent is set for the object, otherwise FALSE. If the name list contains more than one object, then the function returns TRUE if any of them have changed, otherwise FALSE. If any field in the name list is not found, the Unknown value (?) is returned. For example, use this function to check if any of multiple values involved in a calculation or expression have been modified.</td>
</tr>
<tr>
<td>widgetsTrue</td>
<td>Returns TRUE if the value of a LOGICAL object is TRUE, otherwise FALSE. This function does not support SmartDataFields. This function returns the Unknown value (?) if the field is not found, if the value of the LOGICAL is the Unknown value (?), if the widget is not a LOGICAL field, or if the widget is a SmartDataField. Contrast with the widgetValue function, which returns a CHARACTER value.</td>
</tr>
<tr>
<td>widgetLongCharValue</td>
<td>Returns the longchar value of a field. The widgetValue function cannot return longcar values.</td>
</tr>
<tr>
<td>widgetValue</td>
<td>For most objects, returns the INPUT-VALUE of the object.</td>
</tr>
<tr>
<td></td>
<td>For a browse column within a ROW-DISPLAY trigger, the function returns the BUFFER-VALUE from the RowObject buffer field. If INPUT-VALUE returns an ABL error because the value is actually blank, widgetIsBlank will be invoked and blank will be returned. For SmartDataFields, which do not have a standard function for returning an unformatted value, this function does nothing and returns the Unknown value (?).</td>
</tr>
<tr>
<td>widgetValueList</td>
<td>Takes the name of one or more objects and a delimiter and returns the INPUT-VALUE of the object. In the case of a browse column reference from within a ROW-DISPLAY event, it returns the BUFFER-VALUE from the RowObject buffer field. SmartDataFields do not have a standard function for returning an unformatted value, so this function does nothing for SmartDataFields and returns the Unknown value (?). If a field in the list is not found or a field has an Unknown value (?), the function returns “?” for its value in the returned character list.</td>
</tr>
</tbody>
</table>
Organizing logic at the level of procedures or functions

As a general rule when writing your client-side logic, whether it is invoked from the `rowDisplay` procedure or from a UI event action procedure or both, it is advisable to keep it as modular as possible, so that a single logical action is coded as a single internal procedure or function. This makes it simpler to invoke the same logic from both the `Display` event and a particular UI event. In addition, it makes it more straightforward to convert logic as needed to another form, such as JavaScript for a Web interface, and also facilitates the conversion of client code to rules data at a later time. For example, if the code must invoke a specialized block of code on some event, for example to check a credit card number, then if you write just the credit card checking code as a distinct function or procedure, it will be simpler to separate that code, which you must either write by hand for the Web or replace with a standard Web routine to do the same thing, while preserving the standard client API code for the rest of the logic. At a later date, then, it will be more realistic for a migration tool to convert the standard API logic to data, while leaving in calls to specific additional functions you have written.

Customizing dynamic lookup behavior in viewers

The dynamic lookup supports three custom event “hooks” designed to allow developers to extend the behavior of the lookup in various ways. This section describes three named events that the lookup support code publishes, and that custom client code can subscribe to in order to get behavior that goes beyond what the standard lookup provides. You can learn more about the dynamic lookup and the many features of its property sheet in *OpenEdge Development: Progress Dynamics Basic Development*.

**lookupEntry event**

On entry of the lookup field, the `enterlookup` procedure in the lookup support procedure `lookup.p` publishes `lookupEntry` with the following parameters:

```
DEFINE INPUT PARAMETER pcScreenValue AS CHARACTER NO-UNDO.
DEFINE INPUT PARAMETER phlookup AS HANDLE NO-UNDO.
```

A description of the parameters follows:

- **pcScreenValue** — This is the dynamic lookup’s current screen value.

- **phlookup** — This is the handle of the dynamic lookup itself (the SmartDataField™ instance).

The handle of the lookup instance is useful when your viewer contains multiple lookups and you must determine which lookup caused your hook to fire.

To use this event, add a procedure to your viewer’s custom super procedure with the name `lookupEntry` and the above parameters.
Using PUBLISH and SUBSCRIBE properly in super procedures

In initializeObject in the super procedure supporting the lookup, before the RUN SUPER statement, subscribe your viewer to the event using the following statement:

```
SUBSCRIBE PROCEDURE TARGET-PROCEDURE TO "lookupEntry":U IN TARGET-PROCEDURE.
```

Note the format of this SUBSCRIBE statement carefully. It is essential that you always keep in mind that events should almost never be published by or directly subscribed to in super procedures. The super procedure acts in the background on behalf of application objects such as viewers. Thus a SUBSCRIBE statement in a super procedure will normally be qualified by PROCEDURE TARGET-PROCEDURE, meaning that the subscription is registered on behalf of the viewer or other object, not the super procedure itself. And the event will also be qualified by IN TARGET-PROCEDURE, meaning that the interpreter will respond when the event occurs in the viewer or other object, not in the super procedure. Likewise, a PUBLISH statement in super procedure code should normally be in the following form:

```
PUBLISH <event-name> FROM TARGET-PROCEDURE.
```

In this way the interpreter responds to the event as if it had actually come from the supported SmartObject and not from the super procedure itself. Forgetting these forms can cause problems, such as when events do not seem to occur or are not responded to properly.

The lookupEntry event is used within the lookup super procedure lookup.p itself to save the current screen value of the lookup so that on leave of the lookup you can see if it has been programatically changed and allow the standard lookup code to fire, validating the new value. Possible uses in application-specific code could be for programmatic manipulation of properties at run time, or possibly customization of the value based on the value of other fields on your viewer.

**lookupComplete event**

This event occurs on leave of the lookup (published by the procedure leaveLookup in lookup.p) and also on return from the selection of a row in the lookup browse in the procedure rowSelected in lookup.p. lookupComplete has the following parameters:

```
DEFINE INPUT PARAMETER pcFieldNames AS CHARACTER NO-UNDO.
DEFINE INPUT PARAMETER pcFieldValues AS CHARACTER NO-UNDO.
DEFINE INPUT PARAMETER pcKeyFieldValue AS CHARACTER NO-UNDO.
DEFINE INPUT PARAMETER pcNewScreenValue AS CHARACTER NO-UNDO.
DEFINE INPUT PARAMETER pcOldScreenValue AS CHARACTER NO-UNDO.
DEFINE INPUT PARAMETER plBrowseUsed AS LOGICAL NO-UNDO.
DEFINE INPUT PARAMETER phlookup AS HANDLE NO-UNDO.
```
Table 1–3 describes the lookupCompleteEvent parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pcFieldNames</td>
<td>A comma-delimited list of field names (in the form table.fieldname) that includes the key field, the displayed field, all the selected browse fields, and the selected linked fields, each field appearing only once in the list.</td>
</tr>
<tr>
<td>pcFieldValues</td>
<td>A CHR(1)-delimited list of the corresponding values for the fields in pcFieldNames.</td>
</tr>
<tr>
<td>pcKeyFieldValue</td>
<td>The key field value of the selected record.</td>
</tr>
<tr>
<td>pcNewScreenValue</td>
<td>The currently displayed field SCREEN-VALUE.</td>
</tr>
<tr>
<td>pcOldScreenValue</td>
<td>The previously displayed field SCREEN-VALUE before the lookup was done, which can be used to see if the value was changed.</td>
</tr>
<tr>
<td>plBrowseUsed</td>
<td>This logical parameter equals TRUE if the new record was selected from the lookup browse, or FALSE if the new record was selected as a result of manually entering a value without using the lookup browse.</td>
</tr>
<tr>
<td>phlookup</td>
<td>The handle of the lookup SmartDataField instance, used to determine which lookup on your viewer caused the event to occur (in the case where your viewer contains multiple lookups).</td>
</tr>
</tbody>
</table>

To use this event, simply add a procedure to your viewer's custom super procedure with the name lookupComplete and the above parameters. Then in initializeObject of your custom super procedure, before the RUN SUPER statement, add the following line:

```
SUBSCRIBE PROCEDURE TARGET-PROCEDURE TO "lookupComplete":U IN TARGET-PROCEDURE.
```

This hook is useful if you must control the updating of related fields to the lookup field whenever a new value is selected. Remember that the linked fields and widgets instance properties of the lookup can be used to automatically update related fields, so this event is only really for exceptional circumstances where perhaps specific formatting is required of the related fields. It might also be necessary to pass new or linked values on to other viewers, in which case this event could also be useful.

**lookupDisplayComplete event**

This event occurs as soon as the lookup has displayed its values into the lookup's fill-in and linked widgets. The difference between the lookupComplete and lookupDisplayComplete hooks is mainly that the lookupDisplayComplete hook fires every time the lookup displays something. This includes when a viewer initializes.
The `lookupDisplayComplete` event is published from `displaylookup` in `lookup.p` with the following parameters:

```
DEFINE INPUT PARAMETER pcFieldNames     AS CHARACTER  NO-UNDO.
DEFINE INPUT PARAMETER pcFieldValues    AS CHARACTER  NO-UNDO.
DEFINE INPUT PARAMETER pcKeyFieldValue  AS CHARACTER  NO-UNDO.
DEFINE INPUT PARAMETER phlookup         AS HANDLE     NO-UNDO.
```

Table 1–4 describes the `lookupDisplayCompleteEvent` parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pcFieldNames</td>
<td>A comma-delimited list of field names (in the form <code>table.fieldname</code>) that includes the key field, the displayed field, all the selected browse fields, and the selected linked fields, each field appearing only once in the list.</td>
</tr>
<tr>
<td>pcFieldValues</td>
<td>A <code>CHR(1)</code>-delimited list of the corresponding values for the <code>pcFieldNames</code>.</td>
</tr>
<tr>
<td>pcKeyFieldValue</td>
<td>The key field value of the selected record.</td>
</tr>
<tr>
<td>phlookup</td>
<td>The handle of the lookup SmartDataField instance, used to determine which lookup on your viewer caused the event to occur (in the case where your viewer contains multiple lookups).</td>
</tr>
</tbody>
</table>

To use this event, simply add a procedure to your viewer’s custom super procedure with the name `lookupDisplayComplete` and the above parameters. Then in `initializeObject` of your super procedure, before the `RUN SUPER` statement, add the following line:

```
SUBSCRIBE PROCEDURE TARGET-PROCEDURE TO "lookupDisplayComplete":U IN TARGET-PROCEDURE.
```

This event is useful if you want to use the values in the linked fields when the viewer starts up. The `lookupComplete` hook would not be available at this time, as the lookups have not actually been used yet. It might also be necessary to pass new or linked values on to other viewers, in which case this event would also be useful.
Customizing Classes

This chapter provides information about customizing object classes and the new Class Maintenance tool that allows you to view and customize Progress Dynamics® classes. The information in this document provides an overview of classes and class customizations, the maintenance tool, and instructions and steps to perform the various customizations.

This document contains the following sections:

- Overview
- Defining attributes and default values
- Customizing object classes
- Class Maintenance tool
- Additional customization tasks
- Additional resources
Overview

The Progress Dynamics product lets you extend Progress Dynamics object classes to customize the behavior of objects. The product also provides a Class Maintenance tool that allows you to view classes and to help you customize object classes to create new objects or modify existing objects for your applications. This section provides information about the following:

- Progress Dynamics class hierarchy.
- Types of class customizations.
- Definitions.

Progress Dynamics class hierarchy

Progress Dynamics® provides a set of object classes that provide prototype behavior for the objects used to build applications. Classes are arranged in a hierarchy that provides a complete definition of the classes in accordance with object-oriented principles. These classes can be customized to define the behavior of groups of objects.

There are three levels of classes from which you begin a customization:

- **Base class** — This class level is a superset of the ADM static class hierarchy and is extended to include the dynamic Progress Dynamics classes. The classes under this node are the base classes for all SmartObjects, and every object has these attributes.

- **ABL Widget class** — This class level contains the Progress Dynamics representations of ABL widgets. Under this node are all the dynamic classes that represent basic objects such as fill-in, buttons, and rectangles.

- **Progress Dynamics Object class** — This class level contains all other classes and includes the DataField, Entity, and Procedure classes. Most of the classes under this node are procedural classes.

All standard classes and, as a result, objects are derived from these three classes.

For more information about the types of customization you can perform, see the “Class Maintenance tool” section on page 2–10.
Figure 2–1 shows a section of Progress Dynamics class hierarchy.

Types of class customizations

Progress Dynamics framework provides a number of classes that are used to define a collection of objects that you can use to build applications. These object classes are organized into a class hierarchy, and objects can inherit attributes and behavior from all the classes above them in the hierarchy.
When you customize an object class, the class hierarchy is extended to create or modify custom classes and to create new or modify existing attributes and associate them with classes you created. When customizing classes, you can customize them to change either the behavior of all the objects of the class or just some of the objects of the class. For more information about customizing classes, see the “Customizing object classes” section on page 2–7.

Definitions

Throughout the documentation, the following terms are used when providing information and instructions about customizing classes:

- **Attribute** — Provides details about the class. Attributes are also referred to as properties. For more information, see the “Class Maintenance tool” section on page 2–10.

- **Classes** — Represent a collection of objects in Progress Dynamics. Objects are further classified by object type. For more information, see the “Class Maintenance tool” section on page 2–10. You can use the Class Maintenance tool to create or modify classes.

- **Rendering procedure** — Uses information in your Repository to create dynamic objects at run time. For example, for a dynamic viewer using the DynView class, the rendering procedure is `rydynviewv.w`. To define a different rendering engine, you use the `RenderingProcedure` attribute and change the value of the attribute to point to the procedure you want to use for your subclass.

- **Super procedures** — Contain code that provides the standard behavior of a class by either overriding the behavior of the parent class or creating new behavior. The name of the class super procedure is stored in the `SuperProcedure` attribute. You can define custom super procedure behavior for Progress Dynamics objects to provide objects with customized behavior for an application.

- **Supported Links** — At design-time, provide template behavior for the addition of links between objects. At run time, define the extended behavior such as event subscription and handling (get and set methods should exist at the class) for links added between objects. Supported links only exist at a class level and cannot be overridden at the object level.

- **User interface (UI) events** — Provide details about a UI event and the actions performed for specific events.

For more information, see the “Class Maintenance tool” section on page 2–10.
Defining attributes and default values

Attribute values are the primary way to modify class behavior. However, to set attribute values against a class, the attribute must first be defined in the Repository.

Adding an attribute to the Repository

You can add attributes using either one of the following tools:

- Selecting **Attributes** → **Attributes Control** from the Development window to open the Attribute Control window.

- Selecting **Class Maintenance** from the AppBuilder Build menu to open the Class Maintenance tool. From the main window, choose the **Attributes** tab.

When adding an attribute, there is no strict naming convention for custom attributes in Progress Dynamics. Names in the Repository shipped with the product are typically plain text names that do not have a distinctive pattern beyond these basic characteristics:

- Attribute names should be meaningful. Most names use mixed case to separate the parts of a compound named instead of punctuation such as hyphens or underscores. For example, ObjectType.

- The exception to this naming convention applies to attribute names that map directly to native widget attributes in ABL. For example, WIDTH-CHARS. These attributes are in uppercase and use hyphens like the native ABL attributes.

This is done so that the Repository values for the attributes can be mapped automatically and dynamically to the native attributes when objects are created at run time. The uppercase or lowercase letters of the name are not significant as Progress Dynamics names, like ABL names in general, and are not case sensitive. The convention of using uppercase or mixed case helps to identify the origin and use of the name.

Static ADM attribute support

In the ADM, SmartObject attributes (also referred to as properties) are defined in include files that are compiled into each static SmartObject. The first include file (or top file) is src/adm2/smrtprop.i. This file creates a dynamic temp-table named ADMProps and adds fields to the table that define the basic attributes. Each temp-table field defines the name, data-type, and, if appropriate, the initial value of the attribute. The following code below shows the initial basic attributes used by all SmartObjects:

```gh
CREATE TEMP-TABLE ghADMProps.
ghADMProps:UNDO = FALSE.
ghADMProps:ADD-NEW-FIELD('ObjectName':U, 'CHAR':U, 0, ?, ','':U).
ghADMProps:ADD-NEW-FIELD('ObjectVersion':U, 'CHAR':U, 0, ?,
{&ADM-VERSION}':U).
ghADMProps:ADD-NEW-FIELD('ObjectType':U, 'CHAR':U, 0, ?,
{&PROCEDURE-TYPE}':U).
...```
Each file in the class object hierarchy that makes up an object adds one field for each attribute in that class to the temp-table. This creates a temp-table for each procedure-based SmartObject that has one record that holds the attribute values for the specific SmartObject. The initial values of some of the attributes are set by the ADD-NEW-FIELD methods that add fields to the temp-tables dynamically. The remaining attribute values are assigned either at design time or at run time.

The include files also define a number of preprocessor values that begin with \texttt{xp} followed by the name of the attribute. These preprocessor values indicate which of the attribute values can safely be set or retrieved at run time by reading the field directly from the temp-table record. If an \texttt{xp} preprocessor is defined for that attribute, then the information in the temp-table is used. If the information cannot be read from the temp-table, it must be set and retrieved by executing get and set functions for the attribute. Typically, the get and set functions are defined in the super procedure of the class. This is appropriate for cases where the attribute value must be calculated before it is retrieved, or when setting the attribute value has side effects that must be executed in addition to setting the value in the temp-table.

The following code shows the beginning of a list of \texttt{xp} preprocessors from the \texttt{smrtprop.i} file:

\begin{verbatim}
&GLOB xpObjectName
&GLOB xpObjectVersion
&GLOB xpObjectType
\end{verbatim}

When a static SmartObject is compiled, all of the include files that define the attribute fields are compiled into it. Run-time code then sets and manages the values in the temp-table record.

\textbf{Defining support functions for new attributes}

When you define a new attribute that is required for an extended class, you can set a value that registers in the Repository where the attribute can be accessed directly without going through the standard get and set functions. However, this information is used only by the Repository Manager and not by references to the attributes in other code. For this reason, you must either define functions for the attributes or set up a property include file. Since the functions are needed to enable other objects to access your attributes, and for the attributes to work with standard static SmartObjects, it is best to include this file in your compilation.

For more information, see the “Instantiation order for super procedures” section on page 2–8.

\textbf{Special attributes}

There are special attributes the contain link code. This code provides information about where other attributes are read and used.

\textbf{Understanding the rendering procedure}

A rendering procedure creates the dynamic object at run time from data in the Repository. The rendering procedure used in the framework for a specific object is based on the \texttt{Rendering Procedure} property. For example, for a dynamic viewer (the DynView class) the rendering procedure is \texttt{rydynviewv.w}. It is unlikely that you would need to define a different rendering procedure for a subclass of a standard class, but if you did, there is now a way to do so.
To change the rendering procedure for an extended class, change the value of Rendering Procedure to point to the new procedure by entering the relatively pathed filename of the new procedure.

**Understanding the SuperProcedure**

A super procedure contains code that defines the behavior of a class using the attributes, events, and supported links that make up the class. The code in each super procedure provides an override to the behavior of the parent of the class and allows new class-specific behavior to be added.

The name of the super procedure for a class is stored in the SuperProcedure attribute as a relatively pathed filename.

**Caution:** You should not change or add new attributes to the standard Progress Dynamics classes already in the class object hierarchy as shipped with the product. If you do, your extensions might be overwritten and lost when you upgrade to a new version of Progress Dynamics.

**Customizing object classes**

Class customization is done to extend the behavior of a specific class and to provide specific behavior for a subset of objects. You use the Class Maintenance tool to customize class. The steps performed for a customization are the same for both extending the behavior of a specific class and providing behavior for a subset of classes.

**Customizing classes for all objects**

To change the behavior of all the objects that belong to an existing class, you should use the Class Maintenance tool to customize and not extend the class. For more information about customizing classes, see the “Customizing classes for some objects” section on page 2–8. For more information about using the Class Maintenance tool, see the “Class Maintenance tool” section on page 2–10.

The class being customized does not need to be a class that has objects directly associated with it, such as the DynView class that contains dynamic viewers. The class being customized can be any class in the class hierarchy. The higher up in the class hierarchy where customizations are made results in more classes, and therefore objects, being affected.

**Caution:** It is possible to extend the Progress Dynamics behavior by inserting a class between two classes that come with the product. However, this is not the recommended approach as these relationships are overwritten when you install a new version of the product.
Customizing classes for some objects

To customize classes for a group of specific objects, you extend a class by creating a new class. This is called subclassing or extending off the bottom, because in Progress Dynamics, the classes that contain objects are typically bottom classes that have no child or descendent classes.

For example, the DynView class is a bottom-level class, and you can create your own class by extending the DynView class to include specific custom attributes. From this customized class, you could then create custom dynamic viewers that would inherit the behavior of the DynView class as well as the custom behavior and attributes that you add.

If you created a subclass named the FilterView class, and made this class a subclass of the bottom level DynView class, you can use the subclass to provide specific behavior for a specific group of objects. You could then create custom dynamic viewers that would inherit the behavior of the FilterView class.

The following sections provide information about extending a class for a group of objects. When you customize classes from the bottom, the customization only applies to the specific objects that you create from this customized class.

Note: Customizing classes from the bottom does not impact the standard objects that come with Progress Dynamics

After you add new attributes and extend the Object type hierarchy, you must restart your session.

Making customizations to the ADM

If the class being customized is an ADM class (not all Progress Dynamics classes are ADM classes) then the customization should be applied to the static ADM classes. This is particularly necessary when there are static, non-Repository-based objects in the application.

Customized data logic that runs on the AppServer, for example, business logic for SmartDataObjects (SDOs) and SmartBusinessObjects (SBOs), must always be defined in the static ADM files.

Instantiation order for super procedures

Before you customize the appropriate procedure file and define customization in the Progress Dynamics Repository, you should review and set the instantiation order of the super procedures.

When an object is started, all of the super procedures associated with the object’s class and its inherited classes are added to its stack. These super procedures are based on the value of the SuperProcedure attribute in the Repository. The order of the instantiation of these super procedures is based on the class hierarchical structure.
Customizing object classes

The following code illustrates what a typical stack for a dynamic viewer might look like:

```plaintext
ry/prc/rydynviewp.p
adm2/viewer.p
adm2/datavis.p
adm2/containr.p
adm2/visual.p
adm2/smart.p
```

If you extend a class in the middle of the hierarchy, it is important that you define your class in the Repository and assign the SuperProcedure attribute. For example, if you extend the DataVisual and Viewer class, you might have customized procedures `datavisualcustom.p` and `viewercustom.p`. You would then have to create custom classes for both of these classes, to extend the hierarchy, and specify these super procedures in the SuperProcedure attribute. The stack might appear as it does in the following code:

```plaintext
ry/prc/rydynviewp.p
adm2/custom/viewercustom.p
adm2/viewer.p
adm2/custom/dataviscustom.p
adm2/datavis.p
adm2/containr.p
adm2/visual.p
adm2/smart.p
```

If you want to run the static objects in both a Progress Dynamics and non-Progress Dynamics environment, or if you want to run static objects in both a dynamic and static container, you must modify the ADM code to maintain the customization.

The class include files conditionally run the custom super procedures based on the value of the preprocessor `ADM-LOAD-FROM-REPOSITORY`. This ensures that you only run the super procedure if it has not already been loaded from the Repository. If you want your code to behave this way, you must add the following code:

```plaintext
IF NOT {&ADM-LOAD-FROM-REPOSITORY} &THEN
RUN start-super-proc ("adm2/custom/viewercustom.p":U)
```

If you do not qualify the starting of the super procedure, all of the custom super procedures are added on top of the stack, as shown in the following code:

```plaintext
adm2/custom/viewercustom.p
adm2/custom/dataviscustom.p
ry/prc/rydynviewp.p
adm2/viewer.p
adm2/datavis.p
adm2/containr.p
adm2/visual.p
adm2/smart.p
```
Class Maintenance tool

The Class Maintenance tool helps you maintain object classes, their relationships to other object classes, and their related data including attributes, user-interface events, and supported links. The Class Maintenance interface is designed to assist you in creating or modifying object classes. Figure 2–2 shows the Class Maintenance tool.

Figure 2–2: Class Maintenance tool main window

The following sections provide information about the:

- **Menu bar.**
- **Navigation tool bar.**
- **Search panel.**
- **TreeView.**
- **Maintenance pane.**
- **Class Maintenance Preferences dialog box.**
- **Class Maintenance tool and class customizations.**
Menu bar

The menu bar provides access to the following:

- **File** — Provides access to TreeView navigation commands, record maintenance commands, and the following commands:
  - **Translate** — Displays the Translate window, which lets you enter run-time translations for text objects in the calling container.
  - **Map Help Context** — Displays the Map Help Context window, which lets you map help context to one or more objects or widgets in the calling container.
  - **Print SetUp…** — Opens the Print dialog box. Use this dialog box to set up printing options.

- **Options** — Provides access to the Load Custom Attributes window, the Object Type Change Utility, and the Class Maintenance Preferences window.

- **Window** — Enables multiple windows and access to other open windows.

- **Help** — Provides access to help information.

Navigation tool bar

This toolbar contains the following TreeView navigation buttons, as well as an Exit and a Help:

<table>
<thead>
<tr>
<th>Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="First Node Button" /></td>
<td>Move to the first node in the TreeView.</td>
</tr>
<tr>
<td><img src="image" alt="Previous Node Button" /></td>
<td>Move to the previous node in the TreeView.</td>
</tr>
<tr>
<td><img src="image" alt="Next Node Button" /></td>
<td>Move to the next node in the TreeView.</td>
</tr>
<tr>
<td><img src="image" alt="Last Node Button" /></td>
<td>Move to the last node in the TreeView.</td>
</tr>
</tbody>
</table>

Search panel

The search panel lets you easily find a specific class within the hierarchy and has the following components:

- **Class** — The type of object classes to display.

- **Lookup button** — Opens the Lookup Object Type dialog box. Use this dialog box to select a specific object class to find in the hierarchy.

- **Find Button** — Finds the specified object class in the TreeView and displays the node.
**TreeView**

The TreeView pane on the left side of the window displays the class hierarchy of the class objects currently defined in the Repository. Each level (node) in the hierarchy displays the node and the class name. There are three top-level nodes: Base, Progress Dynamics object, and ABL Widget. Beneath each of these nodes there is an Attribute node, a Supported Links node, and a UI Events node. If you customize a class, the customized class appears in the hierarchy with its custom name and a custom icon.

When you select a top-level node from the TreeView, information about the class displays in the maintenance pane tabs to the right. From these tabs, you can maintain information about each class node. To expand a node, click on the plus (+) sign next to the node or double-click the node. To collapse a node, click the minus sign (-) next to the node or double-click the node.

**Maintenance pane**

The Maintenance pane displays detailed information about a selected node. When you select a top-level node, Base, Progress Dynamics object, and ABL Widget in the TreeView pane, information about that node appears in the tabs in the Maintenance pane. If you expand a node and select a specific **Attribute**, **Supported Link**, or **Event** for a class, the Maintenance pane displays a **Detail** tab that you use to view and maintain information.

The Maintenance pane displays the following tabs:

- **Class tab**
- **Attributes tab**
- **Events tab**
- **Supported Links tab**
- **SCM Xref tab**

**Class tab**

The **Class** tab provides details about the selected object class and allows you to view and maintain information about it.

This tab provides the following information:

- **Class Name** — Indicates the name of the selected class being added or updated.
- **Class description** — Describes the class selected for updating.
- **Disabled** — Displays a view-only field used to indicate that the objects in the class are not used.
- **Layout Supported** — Identifies the class object as a noncontainer class object that might require a layout when built dynamically.
- **Static object** — Indicates that the class object is a static object when checked. When cleared, identifies the class object as a dynamic object.
• **Cache on client** — Provides information about this class object when it is cached on the client.

• **Deployment type** — Identifies the type of deployment the class supports. The deployment options indicate the default values for objects within the class and represent the physical locations where the objects will be deployed. One or more of the following deployment types can be specified:
  - Server
  - Client
  - Web

• **Class object name** — Indicates the name of the object class.

• **Class extends** — Indicates the name of a class that this class extends.

• **Customizing class** — Indicates the name of a custom class that this class extends. The custom class cannot be extended from the same class specified in the **Class Name** option.

**Attributes tab**

The **Attributes** tab displays information about all the attributes for the selected class, including all inherited and all customizing attributes.

When changes are made, the current class is updated, not the class at which the attribute is stored. The tab also displays the attribute definitions. The **Attributes** tab contains a Browse and a maintenance pane and provides the following information:

• **Browse** — Lists the attributes of the selected class, the values for the attributes, and information about where the attributes are stored. From this browse, you select the attribute value you want to view and maintain.

• **Description tab** — Displays the name of the selected attribute, a description of the attribute in the Narrative editor, and the data type of the attribute.

• **Advanced tab** — Displays advanced information about the attribute. You can use this tab to specify the following for the selected attribute:
  - **Override** — Indicates the type of override for the selected constant level.
  - **Constant Level** — Indicates whether or not the attribute can be modified.
  - **Run time only** — Indicates whether or not the attributed can be used only at run time.
  - **Design only** — Indicates whether or not the attribute can be used only at design time.
  - **Derived value** — Indicates whether or not the attribute value is derived from data or from another attribute at run time.
Customizing Classes

- **Private** — Indicates whether or not the attribute is private. If an attribute is identified as private, the value of the attribute cannot be accessed outside of the class in which it was defined.

- **System owned** — Indicates whether or not the attribute is system owned. When an attribute is identified as system owned, the user must have the appropriate privileges to modify the attribute. The framework does not enable this feature automatically. To fully implement this feature, you must provide code either in the trigger for the table or the SmartDataObject linked to the table containing the system-owned field.

- **Design** — Identifies how attribute values appear and are populated. This tab has the following options:
  - **Lookup Type** — Specifies how attribute values appear in the attribute value field for a specific object type. Valid values are:
    - **List Item Pairs** — A combo box containing the attribute values overlays the attribute value field.
    - **Dialog** — A lookup button overlays the attribute value field. The lookup button launches the specified dialog box.
    - **Dialog (Read Only)** — Same as the Dialog option, only the attribute value field is read-only, forcing the use of the dialog box. This is necessary for dialog boxes that return delimited lists of values, and when you do not want users to enter values manually.
    - **Procedure** — A procedure returns a string of list-item-pairs, which overlays the attribute value field.
    - **Free Text** — Allows for free text entry.
  - **Lookup Value** — Specifies how to populate the attribute values in the attribute value field, based on the Lookup Type. Valid values are:
    - **For List Item Pairs** — A delimited list of labels and values in the form:
      "label1,value1,label2,value2, ...".
    - **For Dialog/Dialog (Read Only)** — The relative path and filename of a dialog box container. The dialog box must return two OUTPUT parameters: one logical parameter indicating whether the property was changed, and one string parameter containing the value. For example:
      ```
      RUN colorChooser.w (OUTPUT lOK, OUTPUT cValue
      ```
    - **For Procedure** — The relative path and filename of an external procedure that returns a delimited list of list-item-pairs.

- **Where Used tab** — Displays a view-only tab that shows all of the object classes that contain the selected object as an instance. For example, all of the containers in which a specific viewer is used.
Events tab

The **Event** tab displays information about defined Events for the selected class. The **Events** tab has a browser that contains the following columns:

- **Events** — Indicates the name of the event. This name corresponds to an event such as **CHOOSE** or **VALUE** changed.
- **Action** — Indicates the name of the procedure to execute when the specified event happens.
- **Type** — Indicates the type of action to perform. The valid action types are **PUB** for publish and **RUN** for run.
- **Target** — Indicates where the procedure specified by the action should be run or where an event should be published. The valid action targets are **Self**, **Container**, and **Anywhere**. You can also specify a specific manager. When you specify a manager, the action is performed in the target procedure.
- **Parameter** — Identifies a parameter to pass to the event action.
- **Disabled** — Indicates whether or not the event for the selected object class is disabled.
- **Where stored** — Shows which class the event is saved against. This might be different from the class being viewed because the Events browser shows all events that would apply to a class at run time. This can include all events that belong to the ancestors of the class and those that belong to customizing classes.

Supported Links tab

The **Supported Links** tab displays information about links for the selected class. The **Supported Links** tab has a browser that contains the following columns:

- **Link name** — Indicates the name of the link.
- **Link Source** — Indicates that this object class is the source for this SmartLink.
- **Link Target** — Indicates that this object class is the target for the SmartLink.
- **Where Stored** — Displays which class the supported link is saved against. This might be different from the class being viewed because the Links browser shows all links that would apply to a class at run time. This can include all links belonging to the ancestors of the class and those that belong to customizing classes.

This tab has the following options:

- **Link name** — Indicates the name of the link selected in the browse.
- **System owned** — Indicates whether or not the link is system owned. When a link is identified as system owned, the user must have the appropriate privileges to modify the link. The framework does not enable this feature automatically. To fully implement this feature, you must provide code either in the trigger for the table or in the SmartDataObject linked to the table containing the system-owned field.
- **User defined link** — Describes whether or not this is a user-defined link.
SCM Xref tab

The SCM Xref tab is enabled only when the selected class includes SCM Xref information. You can use this tab to maintain this information.

Class Maintenance Preferences dialog box

The Class Maintenance Preferences dialog box lets you specify preferences that control how information is saved. You can use this dialog box to specify whether the changes to a class are saved or cleared when you save a record. Figure 2–3 shows the Class Maintenance Preferences dialog box.

Figure 2–3: Class Maintenance Preferences dialog box

This dialog box has the following options:

- **File** — Provides access to the following options:
  - **Translate** — Displays the Translate window, which lets you enter run-time translations for text objects in the calling container.
  - **Map Help Context** — Displays the Map Help Context window, which lets you map help context to one or more objects or widgets in the calling container.
  - **Exit** — Closes the Class Maintenance Preferences window.

- **Create Custom Class** — Controls whether changes are saved or cleared when you save a record. You can select:
  - **Always** — To save changes every time you save a record.
  - **Never** — To not save changes when you save a record.

- **Clear Button** — Clears any user preferences you might have selected.
Class Maintenance tool and class customizations

The following section describes some of the procedures to follow and the information you need to customize a class, to add or modify attributes, and to save the customized class. This section provides information about:

- Updating class details.
- Updating attribute values.
- Saving attribute values.
- Deleting attributes.

Updating class details

The standard information about a class is maintained in the Class tab. To customize a class, you must provide information about the relationship that the selected class has with other classes. For information about the Class tab, see the “Class tab” section on page 2–12.

To customize a class, you must provide information in the following fields:

- **Class Extends** — This field contains the name of the current ancestors (parent) classes for the selected class. A class only stores the name of its parent. This information is used to construct the class hierarchy, in conjunction with the customizing class, and determines the inheritance and behavior for the object.

- **Customizing Class** — The field contains the name of a class that customizes the current class. This class is a class that customizes the behavior of the selected class. Modified attribute values, UI events, and supported links are stored against this class. It is also used to construct the class hierarchy and modify the behavior of objects inheriting from the selected class and its descendants (children).

Note: For this procedure, you do not need to provide information for the Class Object Name.

When customizing a class, consider the following:

- The class used to customize another typically should not have any objects directly associated with it, as this would cause those objects to behave unexpectedly.

- The customizing class cannot be part of the same class hierarchy as the selected class, as this would cause multiple inheritance. The Class Maintenance tool checks to prevent this behavior.

Updating attribute values

You can view and modify the attribute values associated with a class. The attribute value can also be seen as the default value that a class has for an attribute. This includes all attribute values associated with the ancestor classes of the current class. Attributes are displayed in the updateable browser. For a description of the Attributes tab, see the “Attributes tab” section on page 2–13.
The attribute details reflect the currently selected row in the attribute value browser. Any attribute value can be updated, including run-time and derived attributes. You can:

- Update an existing attribute value.
- Add an existing attribute to the class as an attribute value.
- Add a new attribute and attribute value to the class.

When the browser is in update mode, you can update a value in the browser. Typically, you would enter the new value into the Value column of the browser, although in some cases you must use the lookup button to capture a value. The behavior of these is determined by either the Lookup Type in the attribute definition, or by a default based on the data type of the attribute when no Lookup Type has been specified on the attribute definition.

After you change the value, you can either use the **TAB** key to leave the cell or chose the **Save** button to save the row.

To add an existing attribute to a class, choose the **Attribute** tab and then click **Add** on the Toolbar at the top of the maintenance pane to enable the **Attribute** column.

After selecting an attribute name, the attribute value can be captured.

You can add an attribute definition by using the tool bar at the bottom of the **Attribute maintenance** pane. The attribute details to be captured are on the **Description**, **Advanced** and **Design** tabs in the **Attribute Maintenance Section**. Once an attribute has been added, it can be added to a class as an attribute value in the normal manner.

**Saving attribute values**

When you save a changed or new attribute value, the save process verifies whether the current class is a standard class that ships with the product.

**Note:** Progress Software Corporation recommends that you do not store customizations against the classes shipped with the product, but that you create a custom class and store all customizations against that class. The Class Maintenance Tool automates this process.

If a customizing class already exists for the class, then that class is used to store all customizations.

If there is no customizing class, then the **Create custom** class dialog box opens when you save your changes. From this dialog box, you can choose **Yes** or **Always** to store your changes against a customizing class. For more information about these options, see the “**Class Maintenance Preferences dialog box**” section on page 2–16.

You use the **Custom class name** dialog box to specify the name of the customizing class. You can specify any class name, including the names of existing classes. If the class specified already exists, then it is used as a customizing class. If the specified class does not exist, then you must specify a name to create a new customizing class.

After you save the customizing values, the attribute value browser displays the name of the customizing class in the **Where Stored** column.
Deleting attributes

You can delete any attribute that is stored against the selected class or its customizing class by choosing the Delete button from the tool bar at the bottom of the Attributes maintenance tab.

You can only delete those values stored against the selected class or its customizing class, if any. Other values that are stored against a parent class affects more than just the selected class and therefore cannot be deleted.

Note: To save and delete user interface (UI) events and supported links, you follow the procedures described for attributes and use the Events and Supported links tabs.

Additional customization tasks

When you customize classes, there are a number of tasks to perform in addition to extending the class hierarchy. The following section provides information about:

- Adding the new class to the AppBuilder.
- Adding a custom palette instance.
- Modifying the classes cached at startup.
- Changing the Object type.

Adding the new class to the AppBuilder

The AppBuilder provides access to a Palette that you use to select existing objects to add to a design window and a New... menu item and button to create new objects. The definitions of all the objects on the palette and in the New dialog box are defined in a set of text files called custom files that the AppBuilder reads in when it starts. You can extend these files using a text editor to define new types of objects and individual specialized objects. These files have a filename extension of .cst and are typically located in the src/template directory. If you select the Menu→Use Custom option in the palette, you see a list of the files the AppBuilder reads to build the Palette and the New dialog box.

This object information is also stored in the Repository database, and you can maintain the information through Repository tools rather than manually editing the text files. When you create a new Repository database, the information represented in the standard .cst files is already in the Repository. If you choose the Menu→Use Custom option in the Palette window, you see a list of Repository classes.

Adding a template object record to the Repository

When you create a new class, you must make it available to your application using the AppBuilder. To make a class available, you add a template object record that represents your new class to the Repository.
Adding a custom palette instance

In most cases, subclassing a palette object is not really required. If you just want to define some special attributes for a button type (or any other object type), you can just create a palette instance for it. For example, you can create a new dynamic button that is wider than the normal button.

Modifying the classes cached at startup

Any class in the class hierarchy can be cached automatically at startup to improve the performance of the application modules when they first run. You might want to consider adding the new classes you create to this list. If these classes are part of application components that are typically run, then you might improve the initial performance of your application by adding your classes to the list.

To do this, use the StartupCacheClasses session property to define a comma-separated list of classes, including your custom classes. If you want to define this attribute for one or more of the session types your users will be running in, choose Session→Session Type Control from the Administration menu. Find the session type, for example, ICFRuntime, and expand the node to display the Session Properties node. Right-click on the node and choose Add Session Property.

Enter StartupCacheClasses as the Session Property or select it from the lookup, and enter your list of classes as the value. To cache all classes, use the wildcard value (*).

Note: The number of classes cached at startup might affect the time it takes to bootstrap a Progress Dynamics session. If you leave the property value blank, then classes are cached on demand, which reduces the initial time for bootstrapping a session.

To save this new property value, choose Session→Generate Configuration File from the Administration window to create a new ICFCONFIG.XML file that stores your session values.

Changing the Object type

If you want to change the Object type of the Objects, select the Change Object Type option and enter the target Object type in the To Object Type Code field or use the lookup button. You can change the Object type to any other type either above or below the current Object type in the Object type hierarchy. If you want to change the Object type to a type somewhere else in the hierarchy, for example, to an Object type that is a sibling parallel to the current Object type, then you must first move the Objects up the hierarchy to a common ancestor and then back down the hierarchy to the proper location.

Caution: It is very important that you do not arbitrarily assign new Object types to Objects without considering the effects of this change. Changing the Object type could render some of the attributes useless if the Object type it is being changed to does not have those attributes. Generally, it only makes sense to change an Object type to another closely related type, typically to change Objects to an immediate new subtype or from a subtype back to a standard type.
In considering the relationship between Object types, use the tree view representation in the Class Maintenance tool tree view. This is the definition of the hierarchy that matters when changing Object types because this reflects the actual representation of Object types in the Repository.

The following sections provide information about:

- Changing the object type of a set of objects.
- SCM integration considerations.
- Removing redundant attribute values.
- Removing invalid attribute values.
- Processing the changes.

**Changing the object type of a set of objects**

If you extend a class at the bottom of the hierarchy, you might want to change the object type of a whole set of objects at one time. For example, you might define a new subclass of a standard object type such as DynView and then move either all of your objects or a subset of the object type that require the extended behavior to the new class. Also, if you previously extended a class to provide behavior that is now part of the standard object, you can return your objects to the standard type.

You can move objects to a new type using a utility available from the Class Maintenance tool. In this tool, choose Class Options → Object Type Change Utility.

To operate on a set of objects, enter their object type in the From Object Type Code field or use the lookup button to select an Object type.

You can also select a Product Module to filter objects on that basis.

After you select one or both of these values, click Refresh to display a list of all objects that match your selected values.

The utility allows you to change Object types and to make other changes to the objects you select. If you want your changes to apply to all the Objects in the browse, select the Process All Objects In Browser option. If you want to further subset the Objects, then select Process Selected Objects and use the browse to select the specific Objects you want.

**Note:** If you do not select Process Selected Objects, then selecting individual rows in the browse has no effect.

After you identify a set of Objects, see the “Changing the Object type” section on page 2–20 for a description of how you can modify objects.

**SCM integration considerations**

When extending a class at the bottom of a hierarchy and changing the object types of objects, there are certain SCM implications that you must consider. The new Object Type has to be registered in the SCM Object Type Xref control, which is accessible from the SCM menu option on the Development window. Any required Roundtable subtype change also must be taken into consideration.
Removing redundant attribute values

You can do more than just change Object types using the Object Type Change utility. You can also use it to clean up the attribute values in the Repository. Attribute value records are normally stored only at the highest level at which they have a distinct value. For each Object attribute, an attribute value record with the type’s default value is stored at the level of the class. If that value is not changed in a master Object created from the type, then no attribute value record is stored with the master.

Also, if an attribute for an instance of that master (a Viewer in a particular window, for example) does not have a distinct value for an attribute, then no record is stored at that level. Over time, when moving Objects from one type to another, you might have redundant or invalid attribute value records in the Repository as part of your Object definitions. Redundant attribute value records are those that have a value identical to the default value for Object type. If you have redundant attribute value records, you can improve the performance of your application and reduce the size of the Repository data by removing these records.

You can also improve the maintenance of the class attribute when you want to modify the value. To do this, select the Remove Attributes That Match Object Type Defaults option. If the Change Object Type option is also selected, the attribute values for all the Objects in your list that match the default attribute values of the Object type you are changing to are removed. If you just want to remove these attribute values without changing the Object type, then uncheck the Change Object Type option. Then only the attribute values for the object that match the default attribute values of its current Object type are removed.

Removing invalid attribute values

When you change Objects from one type to another, you might then have attribute values for attributes that are no longer part of the class. These attributes are not retrieved by the run-time API and can be removed. However, you can leave them for informational purposes. To remove the attribute values, select the Remove Attributes That Are Not Part of the Class option. If you are changing the Object type at the same time, this removes attribute values for each Object that is not for attributes of the new Object type. If you are not changing the type, values that are not for attributes for its current Object type are removed. This is usually the result of an earlier change of Object type or some other data conversion. By default, all these options are selected, and as you move Objects from one type to another, both redundant and invalid attribute value records are removed simultaneously.

Processing the changes

Before you use the Change Object Type utility, make sure you have a current backup of your Repository database. After you chose a list of Objects and select the change and remove options you want, click Process. The utility displays a confirmation message describing the changes it is about to make, and prompts you to continue. Click Yes to continue.

If errors occur during processing, an error message appears, processing stops, and any processing that had been done is rolled back. Whether the processing succeeds or is aborted because of an error, a log file named OTC.1og is written to the working directory. This file displays the options that were selected and lists the objects that were processed. If an error occurred, the error message is written to the log file. If you run the utility multiple times, information and messages are appended to the log file. You should clear the log file for better performance.
The Class Maintenance tool is part of the OpenEdge Application Development Environment. The following list provides other sources of information about customizing object classes:

- *OpenEdge Development: Progress Dynamics Repository Reference*
- Progress Dynamics AppBuilder Help
Advanced User Interface Design

A typical Progress Dynamics application has windows with many objects on them, including toolbars with a variety of buttons and menus, and multi-page tab folders with interrelationships between the objects on different pages. The relationships between the objects are determined by SmartLinks™, by properties, and by various functions that control the interactions. Progress Dynamics has many features that support building complex windows and customizing behavior to suit the needs of your application. This chapter describes some of those features and the techniques you can use to take advantage of them.

This chapter describes a single folder window that illustrates many of these features. It is a multi-page window called oemaintwin (for Order Entry Maintenance window), designed to display and update Customer, Order, and OrderLine records in the Sports2000 database. You can assemble the window yourself to follow along with the various examples in the chapter. In describing the window, we presume that you have created a Sports product with an OE product module for Order Entry, done an Entity Import of at least the Customer, Order, OrderLine, Item, and SalesRep tables, and used the Object Generator to create a suite of dynamic objects (SDOs, DataFields, viewers, and browsers) for those tables in the OE product module. See OpenEdge Development: Progress Dynamics Basic Development for guidance on any of these preparatory steps, and also for detailed information on using the Container Builder. To create the window, start with a dynamic independent window (DynObjc), referred to as independent because the window does not expect to receive a key value from another window when it starts up. In general, all the objects you use to create the window can be dynamic objects unless otherwise noted.
The following sections describe how to assemble the pieces of the window and how the window illustrates some of the chapter’s material on user interface design:

- Advanced support for object links
- Modifying visual properties at the master and instance levels
- Disabling and hiding buttons and menu items
- Defining action rules for menu and toolbar items
Advanced support for object links

Communication between the SmartObjects that make up a Progress Dynamics application window is controlled by SmartLinks, or links for short. For more information on the basic ADM2 links and the named events that they handle, see the standard OpenEdge ADM documentation. To learn more about the new links and events and how they are used by Progress Dynamics see OpenEdge Development: Progress Dynamics Basic Development. This section describes features involving links and shows ways to use them in your application, including:

- Using a single toolbar in a multi-page folder.
- Setting up your test window.
- Modifying the default link activation.
- Disabling data links to dependent SDOs.
- Using a GroupAssign link to group pages.

Using a single toolbar in a multi-page folder

One significant improvement in the area of links is that you can use a single toolbar to control objects on any number of pages in a tab folder. For example, a toolbar with one of the Update bands of buttons for Add, Modify, and Delete can be the TableIO-Source for any number of viewers or other updateable objects in a tab folder. The state of the buttons and the equivalent menu items switches automatically as the user selects one page and then another, and the actions on one page properly affect the state of the buttons and menu items on other pages. In addition, a toolbar with a Navigation band can be the Navigation-Source for SDOs on any number of pages in a folder. The state of the buttons changes to reflect the query position of the SDO on each page.

Setting up your test window

To illustrate the toolbar’s ability to control objects on multiple pages, you must create several pages in the window for the toolbar to control, including:

- Toolbar and folder on Page 0.
- Customer objects on Page 1.
- Customer maintenance viewer on Page 2.
- Order maintenance objects on Page 3.
- Defining the Foreign Fields property for a child SDO.
- OrderLine maintenance objects on Page 4.
- Modifying the resize attributes of a browser.
- Summary of all the links for the window.
The first step is to add the basic toolbar and folder on Page 0.

To add the toolbar and folder:

1. Use the **FolderPageTop** toolbar, which has **Update** and **Navigation** buttons and also a standard **File** menu. There are in fact a variety of different built-in toolbars that you can investigate using the Toolbar and Menu Designer, or you can build a new one of your own.

2. Add an instance of the dynamic folder object, called afspfo1dw.w. When you add the folder to the window in the Container Builder, the tool creates a Page link automatically from the folder to the window itself, since this is required for the folder to function properly.

3. In the Container Builder, click **Page Maintenance**:

4. In the **Page Maintenance** window, add four folder tabs with the labels **Customer**, **Maint**, **Orders**, and **OrderLines**:
Customer objects on Page 1

The next step is to put customer information on Page 1.

To add Customer objects on Page 1 of the window:

1. Add a Customer SDO, such as the customerfullo dynamic SDO that the Object Generator created for you.

2. Add a dynamic Customer browser such as the customerfullb that the Object Generator created, where the user can select a Customer record to work with. There is also a viewer under the browser to display a selection of fields that might be helpful. You can build this dynamic viewer in the AppBuilder, selecting just the fields you want to see. In the example this viewer is called custcommentsv, since it features the Customer Comments field.

3. Add the following links:
   - A Navigation link from the toolbar to the Customer SDO on Page 1.
   - A Data link from the SDO to the browser on Page 1.
   - A Data link from the SDO to the viewer on Page 1. The viewer is just for data display purposes, so there is no TableIO link to it and no Update link back to the SDO.

At this point, the window, which comes up with Page 0 and Page 1 displayed, should look like the following:

![Customer objects on Page 1](image)

Note the state of the toolbar buttons. The Next and Last Navigation buttons are enabled to show that the query is now positioned on the first record of the dataset. The Update buttons are all disabled because there is no object on the page that can do an update (and no TableIO link to communicate those Update events through).
Customer maintenance viewer on Page 2

The next step is to create an editable maintenance viewer on Page 2.

To add a Customer maintenance viewer:

1. Add another Customer viewer to Page 2. For Customer maintenance, start with the dynamic `customerviewv`, created by the Object Generator, open it, and rearrange the fields.

2. Add the following links:
   - A Data link from the Customer SDO to this viewer.
   - A TableIO link from the toolbar to the viewer.
   - An Update link from the viewer to the SDO, so that users can add and maintain Customers using the viewer.

Page 2 of the window looks like the following:

![Customer Maintenance Viewer]

Note that because the viewer is a TableIO-Target for the toolbar and an Update-Source for the SDO, the appropriate Update buttons in the toolbar are enabled.
Order maintenance objects on Page 3

Page 3 of the window is for viewing and editing orders.

To add order maintenance objects:

1. In the Container Builder, place the Order SDO orderfullo, the dynamic browser orderfullb, and the dynamic viewer orderview onto Page 3.
2. Edit the viewer in the AppBuilder to arrange the fields more appealingly.
3. Add the following links:
   - A Data link from the Customer SDO on Page 1 to the Order SDO on Page 3.
   - A Data link from the Order SDO to the Order browser.
   - A Data link from the Order SDO to the Order viewer.
4. To enable the toolbar support for this page, define the following links:
   - A TableIO link from the toolbar to the Order viewer.
   - An Update link from the Order viewer to the Order SDO.
   - A Navigation link from the toolbar to the Order SDO.

Defining the Foreign Fields property for a child SDO

When you create a Data link from Customer to Order, you must set the ForeignFields property of the Order SDO to identify which key is passed into the Order SDO to qualify its query.

To define the ForeignFields property:

1. Select the Order SDO in the Container Builder.
2. To the immediate right of the Foreign Fields editor, click the button to bring up the Foreign Fields Mapping dialog box. This dialog box allows you to quickly map sources and targets.
3. Map Order.Custnum to Custnum. This tells the framework that the Order query must be modified at run time to insert the phrase Order.CustNum = <CustNum>, where <CustNum> represents the current value of the CustNum field in the parent Customer SDO:

4. Page 3 of your window should look like this:
OrderLine maintenance objects on Page 4

Page 4 is the OrderLine page.

To define OrderLine maintenance objects:

1. Place the OrderLine SDO orderlinfullo, the OrderLine browser orderlinfullb, and the OrderLine viewer orderlinviewv on this page.

2. Edit the viewer in the AppBuilder to rearrange the fields.

3. Define these links:
   a. A Data link from the Order SDO to the OrderLine SDO.
   b. A Data link from the OrderLine SDO to the OrderLine browser.
   c. A Data link from the OrderLine SDO to the OrderLine viewer.
   d. A TableIO link from the toolbar to the viewer.
   e. An Update link from the viewer to the SDO.
   f. A Navigation link from the toolbar to the OrderLine SDO.

4. Set the OrderLine SDO’s ForeignFields to OrderLine.OrderNum,OrderNum.

Modifying the resize attributes of a browser

Page 4 is sized to fit the overall size of the largest page when you run the window. Because there are typically only a few OrderLine records per Order, the browser might be taller than it needs to be, since by default it is sized to take up all available space on the page after the viewer, which is a fixed size, has been placed at the bottom.

To change this layout behavior:

1. Make sure that the Resize Vertical toggle box is off in the Container Builder for the OrderLine browser. This leaves it at its initial size regardless of the overall size of the folder:
2. Set the **MinHeight attribute** in the dynamic property sheet to change the initial height:

![Dynamic Properties](image1)

**Note:** You can also modify the **MinWidth** and **ResizeHorizontal** attributes. You can set the **ResizeHorizontal** attribute to FALSE and set the **MinWidth** of the browser in order to fix its width in the window so it is always the right size to display its fields.

With the changes to **MinHeight** and **ResizeVertical**, Page 4 looks like this:

![Page 4](image2)
Advanced support for object links

Summary of all the links for the window

The Container Builder’s Link Editor displays a summary of all the links you should have when you have completed these tasks:

![Image of Link Editor]

Modifying the default link activation

As noted, the single toolbar correctly changes its state to reflect which page is the active page. When the window first comes up, the Update buttons are disabled because there is no updateable object on that page. When you select Page 2, 3, or 4, the buttons are enabled.

However, if you select Page 1 again, the buttons remain enabled, which is not correct. This happens because of the setting of the toolbar property DeactivateTargetOnHide. Navigation and TableIO links must be adjusted when the page changes and there is more than one target for the link. These links cannot support more than one active target at a time, since the toolbar must reflect the state of a single object. The DeactivateTargetOnHide property determines how the toolbar handles that adjustment. By default, the property value is FALSE, so when a page containing a TableIO or Navigation target for a toolbar is hidden by a page change operation, the toolbar waits until another page with an object that uses the same link is viewed before re-evaluating the state of the buttons. If every page in the folder has a TableIO link, then as each new page is viewed, the toolbar resets its button state for each new target. In this case the default behavior works fine.
But if there is a page with no TableIO-Target for the toolbar, then nothing happens when the user selects that page, and the state remains set to what it was for the previously selected page. This is normally not appropriate.

In this case you must set the DeactivateTargetOnHide property to TRUE so that the toolbar resets its buttons immediately when a page is hidden. In this way, they remain disabled when the user selects Page 1 after Page 2 because there is no TableIO-Target on Page 1. The downside of this, and the reason why this is not the default behavior, is that this can result in some flashing as the buttons are disabled when one page is hidden and then (perhaps) immediately re-enabled when the next page is viewed.

When you add a toolbar to a static window, there is a custom property sheet, shown in Figure 3–1, that you can access through the AppBuilder and where you can set the property.

![SmartToolbar Properties window](image)

**Figure 3–1:** SmartToolbar Properties window

For dynamic windows, you can bring up the dynamic property sheet, shown in Figure 3–2, for the toolbar in the Container Builder and set the property there.

![Dynamic Properties window](image)

**Figure 3–2:** Dynamic Properties window

After you do this, the Update buttons are always enabled when you select Page 1.

To clarify something about this behavior, bring up your test window and select Page 2. The Customer Maintenance viewer is displayed and the Update buttons are enabled, as they should be. Notice that the navigation buttons are also enabled, which might not seem correct. Given that you just set the DeactivateTargetOnHide property to TRUE and there is no Navigation-Target on Page 2, you might expect that the navigation buttons would be disabled when you select Page 2. What happens, however, is that the toolbar code detects that there is an object on Page 2 that is a Data-Target of the SDO (on Page 1) that is the Navigation-Target of the toolbar. For this reason the standard behavior is to leave the navigation buttons enabled and allow them to navigate through the Customer records from Page 2 exactly as you could from Page 1. If you want to change this behavior, you can use the DisabledActions toolbar property that is described in the “Disabling and hiding buttons and menu items” section on page 3–24.
Disabling data links to dependent SDOs

Another situation that often arises with multi-page windows is that you have a series of SDOs (parent-child-grandchild) on a sequence of pages. When the user views Page 1 and the parent data, by default the Data links between the SDOs send the dataAvailable event on to the next SDO, causing it to open its query using the ForeignFields keys for the currently selected record in the master. You might or might not want this to happen. There is obviously an overhead associated with it, and as the user selects one record or another on the page for the master SDO, it might be useless to retrieve dependent data on another page until it is actually viewed.

You can control this behavior by using the SDO’s ToggleDataTargets attribute. The attribute is TRUE by default, so that behavior is optimized by effectively making the link inactive. What actually happens is that the code unsubscribes the Data-Target to the events that activate the Target to open its query, including dataAvailable. The link itself is still there and can be used for other purposes.

To force dependent SDOs to retrieve dependent data immediately, set the ToggleDataTargets attribute to False for the master SDO (and any other SDOs that have dependent SDOs under them) in the Container Builder property sheet. You can also set this value in the Dynamic property sheet, or you can bring up the object properties for the SDO and unselect Activate/deactivate Data Triggers on view/hide.

Note: The ToggleData SmartLink used in earlier versions of the framework for much the same purpose as the ToggleDataTargets property is no longer actively supported. Use the ToggleDataTargets property instead.

Using a GroupAssign link to group pages

The toolbar also keeps track of whether a GroupAssign link relates viewers on different pages of a folder. To allow an update of many fields to be divided between two or more pages, you can place a viewer on each page for different groups of fields in the same SDO. You then must create the following links:

- A Data link from the SDO to each of the viewers.
- A GroupAssign link from the master viewer, the first in sequence, to each of the other viewers.
- A TableIO link only to the master viewer.
- An Update link from only the master viewer back to the SDO.

All the supporting code treats the multiple viewers as part of a single display-and-update mechanism, and the toolbar does the same.

As an example, you can add a copy of the custcommentsv viewer that appears on Page 1, or any other Customer viewer with a subset of the fields, onto a new page after the maintenance page. In the Container Builder, go into Page Maintenance and add a new Page 3 for comments, pushing the Order and OrderLine records to Page 4 and Page 5.
Drop another instance of the custcommentsv viewer on Page 3, and define these links:

- A Data link from the Customer SDO to the newly added viewer.
- A GroupAssign link from the master Customer viewer customerviewv to the new viewer.

Now when you save and launch the window, you can start an Add or Update on Page 2 and continue it on Page 3, or vice-versa. When you select Page 3, as shown in Figure 3–3, the Update buttons are enabled and have the same state as for Page 2, even though there is no TableIO link to that page at all.

![Figure 3–3: GroupAssign link example](image)

This is because the toolbar recognizes the viewer on Page 3 as being part of a grouped update controlled by the viewer on Page 2.

When you are through experimenting with this, you can delete this Page 3 because it is not used in the remaining examples.

### Modifying visual properties at the master and instance levels

When you first edit the customerviewv viewer and test it in your window, note that some of the fields have a button on the right containing an ellipsis (...). This button brings up a pop-up object to calculate a value for the field. Generally, by default all numeric fields have a Calculator pop-up, and all date fields a Calendar pop-up. If you want to turn this off for a field like the CustNum because it is not appropriate for that field, you can do this globally by changing that property in the DataField object. Because of the inheritance model in Progress Dynamics, that property setting for the master field-level object is inherited by all uses of that field in viewers and other objects unless it is specifically set otherwise.
Setting a property at the master level

You set a master property with the Repository Maintenance tool.

To set a property for a DataField to apply to all uses of that field:

1. Open the Repository Object Maintenance tool from the Build menu and enter the field name, which is always qualified by the database table name it is derived from:

2. Expand the objects node for the field in the tree view, then the field node itself, and then the Attributes node. Here you see all the properties for the DataField that are predefined.

3. Select the Label attribute.

4. Click Modify in the Maintenance frame, and set its value to Customer Number by typing in the Attribute Value field.

When you run any container with the CustNum field in it, such as the window you are building now, it reflects this change, unless the CustNum value has explicitly been set in the viewer or the container window.
Setting properties at the instance level

You can set field properties for a viewer when you edit the viewer in the AppBuilder. When you do, you edit the properties at the instance level, because you are setting the property only for this particular instance of the field, when it is displayed in this particular viewer.

The AppBuilder provides two ways of setting field (or other widget) attributes. If you double-click on a field, the same property sheet that you always use appears, customized to show the attributes for the widget type (fill-in, editor, button, and so on). When you change attributes here, the AppBuilder saves them to the Repository when you edit a dynamic object. For instance, Figure 3–4 shows the CustNum field in the customerview viewer.

![Property sheet for the CustNum field](image)

**Figure 3–4:** Property sheet for the CustNum field

Here you can disable the field and set other properties just as you always could. In this case we have disabled the field by setting the Enable property to FALSE and the Read-Only property to TRUE. A few of these properties, such as Show-Popup, are new with Progress Dynamics, but otherwise the property sheets are as they always have been.
Using the Dynamic property sheet to set properties

You can also set properties in the new dynamic properties sheet by selecting it from the AppBuilder’s Window menu. This shows all properties for the selected object and lets you set properties for it or select other objects in the same container. Figure 3–5 shows some of the properties for the CustNum field in the customerviewv viewer.

![Dynamic properties sheet](image)

**Figure 3–5: Dynamic properties sheet**

This property sheet is described in detail in *OpenEdge Development: Progress Dynamics Basic Development*, but it is useful to point out a few things in this example:

- If you look at the ShowPopup attribute, you see that its value is No. The row is not marked by an asterisk (*) or check mark in the first column, which means that the value was not modified for this instance. This is a value inherited either from the class for the object type or (as in this case) from the master object. Because you changed the value for the CustNum field in the Repository Maintenance tool, that modified master value is inherited by this instance.

- If you look at other attributes, you can see that some of them have been overridden or set specifically for this instance, including the Order (indicating that the CustNum field is the first field in the tab order for the viewer), the row it is displayed in, and the RowObject TableName used because the viewer is derived from an SDO. These are all attribute values that were set automatically when the instance of the viewer was created in the window, but they are still different from the master values, and so they show as overrides. In addition, the Read-Only attribute is Yes, and this is also shown as an override. This is because we set the attribute value in the standard AppBuilder property sheet for the field.
• If you double-click on the viewer itself, outside any field, or click Object Properties in the AppBuilder toolbar, then the viewer’s property sheet shown in Figure 3–6 appears.

Figure 3–6: Viewer property sheet

Here you can set properties that apply to the viewer itself. Because you are doing this in the viewer’s design window, you are setting these attributes at the master level (there’s no higher level for this customerview\textunderscore viewer). Here, for instance, you can turn the Show-Popup attribute off for the viewer, because this attribute is supported both for individual fill-ins and for viewers. If you set it to FALSE for the viewer, this removes all pop-up buttons for all fields in the viewer.

• You can also set this property in the dynamic property sheet in the same way you did for the Cust\textunderscore Num field. By contrast, you can set the attribute to FALSE for the viewer just when used in the oemaintwin window by bringing up the dynamic property sheet in the Container Builder for oemaintwin. When you do this you are editing a specific container that uses the viewer, so any attributes you set for the viewer are set only for this instance of its use.

So to summarize, the level at which you set attributes depends not on the tool you are using, but on the context of where you are using it.

If you create or edit a viewer in the AppBuilder and set one or more viewer attributes, either in the viewer property sheet provided by the AppBuilder or in the dynamic property sheet you can run from it, you are setting attributes at the master level for the object you are creating.

If you define attributes for a Data\textunderscore Field object in the Repository Maintenance tool, you are also doing it at the master level for all uses of the field.

On the other hand, if you bring up the custom property sheet in the AppBuilder for a field or widget of a specific type, such as the one you saw for the Cust\textunderscore Num field, you are defining attributes of that field as used in that particular viewer. So you are defining attribute values at the instance level. Any such settings will be seen only in the context of the viewer you are editing.
Likewise, if you use the dynamic property sheet to define attribute values for fields in a viewer, the same thing is true: you are defining instance attribute values.

To move the discussion up a level in the object hierarchy, if you are creating a container window in the Container Builder, you can click the **Container properties** button to set property values for the window itself:

![Container properties](image)

These are values at the master level, because you are defining property values for the window you are currently creating:

![Dynamic Properties](image)

On the other hand, if you bring up the property sheet for one of the viewers or other objects you place into the container, then you are defining values at the instance level for the object.

**Attribute value level summary**

It is important to keep these distinctions in mind so that you do not define behavior changes whose scope is larger or smaller than you want. As with any programming exercise, it is always best to do the job once and only once. So if you want to remove the **Calculator** pop-up from the **CustNum** field everywhere it might ever appear, you should do this at the master level, using the tool that gives you access to the attributes at that level (the Repository Maintenance tool, in this case). That way you never have to change the property when you use the field. It also means that you can change your mind about this new default value and only have to change data in one place. Because of the Progress Dynamics inheritance model for attribute values, the change in value at the master level will be inherited by any instance (that is, any use) of the object where the attribute has not specifically been set to some value.

On the other hand, when you want a change in default behavior to be seen only in the current context, then set the property value at the instance level using the available tools.
Advanced User Interface Design

To review, for master objects:

- You can set master attribute values for DataField objects (individual database fields as used in the framework) in the Repository Maintenance tool. Because the Repository tool shows you the actual records in the Repository database, it will not show any value for an attribute whose value is inherited from its class, so, as you saw for the ShowPopup example, you might need to add a record to define the attribute value.

- You can set master attribute values for SDOs, viewers, and browsers in the AppBuilder. You can either use the AppBuilder’s own custom property sheets for these objects (by double-clicking on the object in its design window, for example) or bring up the dynamic property sheet from the Window menu.

- You can set master attribute values for windows in the Container Builder by clicking on the Container properties button.

And for instances:

- You can set instance attribute values for DataFields in the viewer where you use the field, when you edit the viewer in the AppBuilder, using either the AppBuilder’s custom property sheet for the field type or the dynamic property sheet.

- You can set instance attribute values for SmartObjects such as SDOs, browsers, viewers, toolbars, and folders by editing the window where the object instance occurs in the Container Builder and bringing up the dynamic property sheet for the object.

The attribute control and the object type control

Although this chapter does not go into a detailed discussion of how attributes are created, there are a few basic pieces of information concerning attributes that are important to mention here.

First, every attribute in Progress Dynamics is defined in the Repository database. Attributes can be added and edited using the Attribute Maintenance window on the Progress Dynamics Development window’s Attribute menu.
Figure 3-7 shows the definition of the ShowPopup attribute.

Figure 3-7: Attribute Maintenance window

There are a few key things to note about this definition that will help you understand how you can modify attribute values.

The **Constant Level** defines the lowest level of the attribute hierarchy at which a value can be defined for the attribute. This can be:

- **Class** — The attribute is given a value for a class, and that value can never be changed for any object in the class. An example of this is the `SupportedLinks` attribute, which is defined once for each SmartObject class. If you try to edit an attribute whose **Constant Level** is **Class** and you use the dynamic property sheet, you see that the initial value of the attribute is displayed, but you cannot change it.

- **Master** — The attribute is given a value for each master object created in the class, and that value cannot be changed in an instance. If you try to edit an instance attribute whose **Constant Level** is **Master** and you use the dynamic property sheet, you see that the initial value of the attribute is displayed, but you cannot change it. An example of this is the `ObjectName` attribute.

- **Instance** — The value can be changed for any instance of the object.

There are five toggle boxes on the window that also help identify where and how you can change the attribute value:

- **Private** — If this toggle box is checked, then the attribute is intended for internal use only. Private attributes are not displayed in the dynamic property sheet and should never be modified by application code. Note that the functions that set and get the attribute value might not themselves actually be declared as PRIVATE for programming reasons, but you should not use them.
• Runtime Only — If this toggle box is checked, then the attribute’s value is only set to a meaningful value at run time. It makes no sense to set the value at design time in one of the application design tools. Examples of this include attributes whose values are handles, such as DataSource, and attributes that record the current state of an object at run time, such as objectInitialized. These attributes also do not appear in the property sheet.

• Design Only — If this toggle box is checked, then the attribute’s value is only meaningful at design time. These attributes are also not displayed in the property sheet because their values are not used at run time.

• Derived Value — If this toggle box is checked, then the attribute value is derived from a calculation that is done by the get and set functions for the attribute and is not actually stored with other attribute values. An example of this is the UpdatableColumns property of an SDO, which is derived from another property called UpdatableColumnsByTable, which itself is used only internally. Because such values are not stored within the SmartObjects or in the Repository, they are also not included in the dynamic property sheet.

• System Owned — If this toggle box is checked, then the attribute is essential to the workings of the framework and the basic behavior of applications. These attributes and their initial values should not be changed. Developers need special privileges to change these. Many of these attributes can, however, be set and used at run time.

Thus, you see that many attributes used internally are not displayed in the property sheet for a variety of reasons.

The Lookup Type drop-down list lets you define the way in which the attribute is edited in the Dynamic property sheet and includes the following types:

• Free Text — Fill in the attribute value in the property sheet.

• List Item Pairs — You select a value from a list of possible values. The items are in pairs because the value stored in the Repository might be a coded value that is not displayed to you.

• Dialog — You bring up a custom dialog box to edit the property value. You can also type directly the attribute value. The dialog box is specified in the lookup field value.

• Dialog (Read Only) — You bring up a dialog box to edit the property, and you cannot choose any value not presented to you in the dialog box. The Color properties, for example, use a dialog box to choose from a color editor.

• Procedure — The property sheet runs a user-defined procedure to edit the attribute value.

There are other limits in defining and using attributes. One important characteristic of an attribute that is not defined in the Attribute Maintenance window is its initial value. This is because attributes are not given values until they are associated with a class. You do this in the Object Type Control window under the Dynamic Development window’s Object menu. This tree view-based window shows all the Object classes in a hierarchy starting with Base, which represents the smart class common to all SmartObjects. Attributes are defined for each class, so an individual object inherits attributes and their initial values from all the classes in its branch of the hierarchy.
Modifying visual properties at the master and instance levels

Figure 3–8 shows an example of drilling down through the DynView class to locate the FrameMinHeightChars attribute.

![Figure 3–8: Object Type Maintenance window](image)

The organization of the hierarchy is not entirely accurate for all objects. Some classes such as AppServer are optional parts of other classes, but the TreeView does not represent this option. This is why to locate the DynView class, you expand the Base class, then AppServer, then Visual, then Container (again optional, as a viewer can be a container if it has SmartDataFields such as dynamic lookups and combos in it), then DataVisual, then viewer. This is where you define the default value, if any, for an attribute as used in that class.

It is important to understand that every attribute you use in an object must be defined for the object type at this class level. You cannot simply add an attribute to a single object or a single instance of an object. So when, for example, we described adding an attribute value record for a DataField in the Repository Maintenance tool, this was because attribute values are stored at that level only if they override the default values for the class. So when you add an attribute value record, it must be for an attribute that is defined for one of the classes the object inherits from.

Obviously, all the attributes that are needed to provide all the standard behavior for all the objects in the framework are predefined in the Repository, and in principle, you are likely never to need to use these tools. However, if you define your own objects or create a subclass of an existing object, you can add new attributes that your application needs the objects to have.
Disabling and hiding buttons and menu items

The Progress Dynamics toolbars are made up of buttons and menu items whose state changes as the application runs. You see this whenever you navigate through records or make changes to a record and click Save. Later we discuss how to define the specific logic for instances when items are enabled and disabled, hidden and viewed, or the button image is changed. This section discusses how to define the list of items that should be removed from a toolbar at run time, either by hiding them or disabling them.

Obviously, if your application needs a toolbar that does not match any of the standard toolbars already defined in the framework, you should define a toolbar that has exactly the items you need on it. But sometimes you might want to disable or hide items programmatically under certain circumstances, so that they are sometimes available and sometimes not. There are two toolbar properties and several functions that assist you in doing this. The properties are DisabledActions and HiddenActions.

Disabling actions based on a data value

For example, suppose that you want users of the oemaintwin window you built to be able to edit or delete only Customers and Orders for Customers in the USA. To do this, you must disable the buttons that allow those operations, depending on the value of the currently selected Customer, and enable or disable the fields in the viewers on the different folder pages accordingly.

Using the TableIOType property

The first thing you must do is to change the basic display mode of the toolbar to leave viewers disabled until someone specifically wants to do an update. That way, the viewers are initially disabled, and the user must have access to the Modify button to make changes.

In earlier versions of the ADM and its SmartPanels, this was done with the PanelType property, which you could set to one of two states:

- **Save** — Puts the buttons and their TableIO-Targets into a state where everything is enabled and the user just makes changes and selects the Save button to record them.

- **Update** — Disables TableIO-Targets and places the buttons into a state where the user must click Update to enable the viewers and begin to make changes, and then click Save when done.
Disabling and hiding buttons and menu items

The toolbar equivalent of this property is TableIOType, and it has the same two possible values: Save and Update. The default setting is Save, so things start out enabled. You must change the setting to Update for this example to work. Change the value in the Container Builder, by bringing up the toolbar’s dynamic property sheet, as shown in Figure 3–9, and changing the property value there.

Figure 3–9: Dynamic Properties window

There is another way to make run-time changes to the object in a custom super procedure that executes custom code when the window is initialized. You can define a custom super procedure for the toolbar itself, but because this must be done as part of the overall window initialization, this example shows the code in a custom super procedure for the container window. Where you put your code is a matter of overall organization and preference; there is always more than one solution to a programming problem.

Defining a custom super procedure for the window

Define a New Structured Procedure in the AppBuilder and create an initializeObject internal procedure for it. Because this code is executed on behalf of the window, it first must get the handle of the Toolbar object. To do this, add a ContainerToolbar link from the toolbar to the window (THIS-OBJECT), which might be useful for other purposes as well, as is described in a later section of this chapter. Alternatively, the code could simply check among the window’s Container-Targets for the handle of an object with the ObjectName of FolderPageTop. Again, there is almost always more than one way to solve a problem.

Given the toolbar handle, you then must set the TableIOType property to Update. This code sample uses the (get) and (set) include files to do the job. You could also use the DYNAMIC-FUNCTION syntax and the equivalent get and set functions for the same effect. This is also mostly a matter of personal preference and coding style. This all must happen before the RUN SUPER statement so that the property is set before all the objects are initialized, as shown in the following code:

```plaintext
Procedure initializeObject:
/*---------------------------------------------
Purpose:    Override of initializeObject to reset the TableIOType property value to 'update' so that Viewers are initially disabled.
Parameters: <none>
---------------------------------------------*/
DEFINE VARIABLE hToolbar AS HANDLE     NO-UNDO.
{get ContainerToolbarSource hToolbar}.
{set TableIoType 'update' hToolbar}.
RUN SUPER.
END PROCEDURE.
```
Registering the custom super procedure

As always, remember to register your super procedure in the Repository by selecting that option in the AppBuilder’s File menu. Save it as a Procedure in the appropriate product module. We have called the procedure oemaintwinsuper.p.

Once you have done this, attach it as the custom super procedure for the container window. You can do this in the Container Builder, as shown in Figure 3–10.

Figure 3–10: Container Builder for oemaintwin

Note that you can set the custom super procedure for objects that are edited in the AppBuilder, such as browsers and viewers, in the AppBuilder’s property sheets for those objects.

As mentioned elsewhere, you do not specify the relative pathname where the procedure is actually stored because you are just providing its LogicalObjectName as stored in the Repository. This name includes the .p filename extension but not the pathname. The pathname is attached automatically at run time by looking up the product module record in the Repository.

Defining a custom super procedure for a viewer

Now that you have set the TableIOType property, you must create code to selectively enable and disable both the toolbar buttons and the viewer fields depending on the value of the Customer Country field. Put this code into a custom super procedure for the custcommentsv viewer that we have named customersuper.p. See the “Defining a custom super procedure for the window” section on page 3–25 for more information on how to create this procedure.

Using the modifyDisabledActions procedure in the toolbar

To control the toolbar buttons and associated menu items, change the DisabledActions or HiddenActions attributes. In this example, you should disable the buttons and menu items rather than hide them so that they do not appear and disappear as the user changes records, which would not be an appropriate user interface. In other situations you can remove the button or menu item from the toolbar altogether by adding it to the HiddenActions property.

There is a special support procedure to help you add and remove entries from the DisabledActions property, whose value is a comma-separated list of actions. Note that at present there is no equivalent procedure for HiddenActions; you will have to parse the list yourself or create your own modifyHiddenActions procedure based on modifyDisabledActions.

First you must identify the names of the actions that you are going to disable. To identify these names, open the toolbar in the Toolbar and Menu Designer. Expand the SmartToolbars node and locate the toolbar you are using, which is FolderPageTop in this case. Expand that node to see the bands it uses, and then expand the TableIoMod band, which holds all the update-related actions. Here you can see the description of each action.
Following the description is the actual action name in parentheses, which also appears as the **Item Reference** in the maintenance frame to the right, as shown in Figure 3–11. This is the name to use in setting `DisabledActions`.

**Figure 3–11: Toolbar and Menu designer**

To disable the **Delete** button in the **FolderPageTop** toolbar, and also the two buttons that allow you to alternate the state of the displayed record from **View** mode to **Update** mode, you must add **Delete**, **FolderView**, and **FolderUpdate** to the list.

Since you need to do this each time a **Customer** is selected, the appropriate place for the code is in a local version of the **dataAvailable** event procedure. This is published by the SDO each time the record position changes and the viewer subscribes to the event so that it can display the new values. Unlike most event procedures, which have no parameters, this one has a single `INPUT` parameter that you must define and pass on to the super procedure. See Chapter 5, “Using ADM2 Properties and Methods,” for more information on this and many other useful properties and entry points in the code that you might want to use.

**Important note about parameters on overrides and publish**

Remember to double-check for parameters in any procedure that you are going to override and in any event that you publish. If you get the parameter list wrong for a local version of a procedure that you **RUN**, you will get an error at run time to remind you of your mistake. But if you get the calling sequence wrong for a **PUBLISH** statement, the event simply will not occur because there will not be any matching subscriber with the same parameter list.

Unfortunately, when you create a custom super procedure and add code to it in the AppBuilder, the Section Editor is not aware of what object it will be associated with, so it cannot supply you with a list of all the valid procedures and functions you can override, along with their parameters, as it does when you add procedures to a static SmartObject. Therefore, make sure you get this right. Also, do not forget to include the **RUN SUPER** statement in the right place in your custom code. If you leave it out, the standard code for the event will not execute at all, and the results will likely be very strange.

**Getting values from different linked objects**

Your custom code must first get the handle of the toolbar. Because there is no link from the toolbar to the **Comments** viewer (the viewer is not updateable, so it has no TableIO link), you must get the handle of the **Customer** SDO, which is the viewer’s **Data-Source**, and then get the SDO’s **Navigation-Source**, which is the toolbar.
You also need to retrieve the value of the **Country** field for the selected record. You can use the `columnValue` function in the SDO to do this.

And finally, the code must get a list of all the TableIO-Targets of the toolbar (which are the three updateable viewers on Pages 2, 3, and 4). This is the `TableIOTarget` property. Though the name is singular (**target** not **targets**), the data type is `CHARACTER`, because there might be a list of handles of multiple targets, stored as a comma-separated list of handles in string form, as shown in the following:

```
Procedure dataAvailable:
/*-------------------------------------------------------------------------
Purpose:  Override of dataAvailable to reset the DisabledActions of the toolbar and enabled or disable fields based on the Country.
Parameters:  pcRelative AS CHARACTER
Notes:
-------------------------------------------------------------------------*/
DEFINE INPUT  PARAMETER pcRelative AS CHARACTER  NO-UNDO.
DEFINE VARIABLE cCountry    AS CHARACTER  NO-UNDO.
DEFINE VARIABLE hDataSource AS HANDLE     NO-UNDO.
DEFINE VARIABLE hToolbar    AS HANDLE     NO-UNDO.
DEFINE VARIABLE cTargets    AS CHARACTER  NO-UNDO.
DEFINE VARIABLE hTarget     AS HANDLE     NO-UNDO.
DEFINE VARIABLE iTarget     AS INTEGER    NO-UNDO.
ASSIGN hDataSource = DYNAMIC-FUNCTION ('getDataSource' IN TARGET-PROCEDURE) hToolbar    = DYNAMIC-FUNCTION ('getNavigationSource' IN hDataSource) cCountry    = DYNAMIC-FUNCTION ('columnValue' IN hDataSource,'Country') cTargets    = DYNAMIC-FUNCTION ('getTableIOTarget' IN hToolbar).
IF cCountry EQ "USA" THEN
  DO:
    DYNAMIC-FUNCTION ('modifyDisabledActions' IN hToolbar, 'Remove', 'FolderUpdate,FolderView,Delete')
  END.
```

Next, the code checks the value of the Country field and runs `modifyDisabledActions` to either add or remove the actions. Remember that the goal is to allow users to edit and delete only records related to customers in the USA. The `modifyDisabledActions` procedure takes two arguments:

- **Add or Remove** — To indicate whether to add actions to or remove actions from the list of disabled actions.
- **Action List** — A comma-separated list of action names.

If the country is USA, the user is allowed to do updates and deletes, so the actions are removed from the disabled list, as shown:

```
IF cCountry EQ "USA" THEN
  DO:
    DYNAMIC-FUNCTION ('modifyDisabledActions' IN hToolbar, 'Remove', 'FolderUpdate,FolderView,Delete')
  END.
```
Using enableFields and disableFields

Then the code goes through the list of TableIO-Targets, converts each back to a handle, and runs the enableFields procedure in it. In order to avoid doing this unnecessarily, it first checks the value of the viewer's FieldsEnabled property to see whether the fields are already in the right state, as shown:

```plaintext
DO iTarget = 1 TO NUM-ENTRIES(cTargets):
    hTarget = WIDGET-HANDLE(ENTRY(iTarget, cTargets)).
    IF NOT DYNAMIC-FUNCTION('getFieldsEnabled' IN hTarget) THEN
        RUN enableFields IN hTarget.
    END.
END.
```

Correspondingly, if the country is not equal to USA, then the actions are added to the disabled list and the code must run the disableFields procedure in the viewer. This is another case where you have to be careful to get the calling sequence right. Unlike enableFields, the disableFields procedure takes an INPUT parameter, which can be All or Create to indicate whether all fields are to be disabled, or just those associated with creating a new record, as shown:

```plaintext
ELSE DO:
    DYNAMIC-FUNCTION ('modifyDisabledActions' IN hToolbar, 'Add', 'FolderUpdate,FolderView,Delete').
    DO iTarget = 1 TO NUM-ENTRIES(cTargets):
        hTarget = WIDGET-HANDLE(ENTRY(iTarget, cTargets)).
        IF DYNAMIC-FUNCTION('getFieldsEnabled' IN hTarget) THEN
            RUN disableFields IN hTarget ('All').
        END.
    END.
END.
```
This is the end of the code for the viewer’s localization of dataAvailable. Be sure to register the super procedure in the Repository and associate it with the viewer. You can set the custom super procedure for the viewer in the Repository Maintenance tool, or more conveniently in the AppBuilder, by opening the viewer and going into its property sheet, as shown in Figure 3–12.

![Property sheet for frMain](image)

**Figure 3–12:** Property sheet for frMain

**Testing the window with DisabledActions**

Now, when you run the application window and select a customer not in the USA, all the viewers are disabled. The **Delete**, **View**, and **Modify** actions in the toolbar are also disabled, as shown in Figure 3–13.

![Test of window with DisabledActions](image)

**Figure 3–13:** Test of window with DisabledActions

**Using the toolbar’s reset procedures**

The toolbar uses a set of event procedures to reset the action state for various types of actions. These procedures are executed when it seems correct to check for a state change. As a result, you do not normally need to run them yourself. For instance, they are run on a page change, which is why the action state is corrected when you switch pages.
The event procedures that the toolbar supports are `resetTableIo`, `resetCommit`, and `resetNavigation`. These are published by objects like the viewer, and generally you do not need to invoke them explicitly. If you find that the toolbar state is not being reset properly at some particular place in your application, such as this viewer, you can simply publish the event from the viewer and the toolbar will receive it.

Remember to publish it FROM TARGET-PROCEDURE so that the event is associated with the viewer itself and not its super procedure. This is what the first block of code looks like with an example of publishing `resetTableIo` to make sure that the update buttons are reset properly:

```plaintext
IF cCountry EQ "USA" THEN
  DO:
    DYNAMIC-FUNCTION ('modifyDisabledActions' IN hToolbar,
    'Remove', 'FolderUpdate,FolderView,Delete').
    PUBLISH 'resetTableIo' FROM TARGET-PROCEDURE.
    DO iTarget = 1 TO NUM-ENTRIES(cTargets):
      hTarget = WIDGET-HANDLE(ENTRY(iTarget, cTargets)).
      IF NOT DYNAMIC-FUNCTION('getFieldsEnabled' IN hTarget) THEN
        RUN enableFields IN hTarget.
    END.
  END.
END.
```

You can also publish the general-purpose reset procedure `resetTargetActions` to reset actions related to other link types, including custom links of your own. The procedure takes the name of the link as an INPUT parameter.

### Putting the value check into the window code

Now that the example is complete, you can look at an alternative way to do the same thing. Consider the procedures that you have just created. Most of the work is done in a custom super procedure attached to the read-only `Customer` viewer on Page 1 of this window. It is important to keep in mind that you can define a custom super procedure for an object only at the master level, for the object itself, and not for a single instance of the object in a particular window. In this case, it might not be appropriate to have the `dataAvailable` code associated with that viewer, because the special behavior it defines is really specific to this one window. In fact, the code would generate numerous errors if the viewer were in a different window, because the code as it stands assumes various things about what objects are in the window and what links there are between them. This in itself is worth correcting by improving the code to deal gracefully with its context if the window design is changed in some way.

If you do not want to associate the behavior specifically with the `custcommentsv` viewer, you can instead tie it to the window by putting the code into the `oemaintwinsuper.p` procedure. Let's look at that alternative and see what changes you have to make to the code in its new location.

First, look at the `initializeObject` procedure in `oemaintwinsuper.p`. The reason it seemed more natural to add the new behavior to the `Customer` viewer is that it required localizing the `dataAvailable` event, which the viewer subscribes to in the SDO. The container window does not subscribe to this event, and therefore does not normally receive it. This is the first thing you must change in order to move the code to the window.
You can intercept this event in the window simply by adding a statement to subscribe to it. So this new version of the initializeObject code has a few additional lines in it. The first line gets the handle of the Customer SDO by retrieving the Navigation-Target of the toolbar. The NavigationTarget property is of data type CHARACTER, so you must retrieve it into a CHARACTER variable and then convert that to a handle.

**Note:** The DYNAMIC-FUNCTION operation that takes place inside the {get} is forgiving enough that it actually casts the CHARACTER output from the getNavigationTarget function directly into the HANDLE variable hSDO. You would be well advised not to take advantage of the run-time engine’s generosity in this regard. In particular, if the {get} is turned into a direct lookup in the properties temp-table instead of a function call, you will get an error from your attempt to combine the two steps.

Keep in mind that the reason the NavigationTarget property is of type CHARACTER is that there could be more than one navigation target for the toolbar, in which case the multiple targets would be represented as a list. In this case there is only one, because at the time initializeObject gets run, only Page 0 and Page 1 of the folder have been created, so there is only one SDO in the window. Try not to make this kind of assumption in your own finished application code, so as to avoid errors if the window you are working with changes later on.

The code you must add in this initializeObject procedure is highlighted in bold, as shown:

```
Procedure initializeObject:
/*----------------------------------------------------------*/
Purpose: Override of initializeObject to reset the TableIoType property value to 'update' so that viewers are initially disabled.
Parameters: <none>
----------------------------------------------------------*/
DEFINE VARIABLE hToolbar AS HANDLE NO-UNDO.
DEFINE VARIABLE cSDO AS CHARACTER NO-UNDO.
DEFINE VARIABLE hSDO AS HANDLE NO-UNDO.
{get ToolbarSource hToolbar}.
{set TableIoType 'update' hToolbar}.
{get NavigationTarget cSDO hToolbar}.
hSDO = WIDGET-HANDLE(cSDO).
SUBSCRIBE PROCEDURE TARGET-PROCEDURE TO 'dataAvailable' IN hSDO.
RUN SUPER.
END PROCEDURE.
```

Once you have the handle of the SDO you can subscribe to dataAvailable. Again, remember to subscribe the TARGET-PROCEDURE, not the super procedure itself. Now the window will get dataAvailable events just as the viewer does.

The next step is to move the dataAvailable code itself from the viewer’s super procedure to the window’s. You can then delete the viewer’s super procedure and remove its association from the viewer in the Repository Maintenance tool.

Because the dataAvailable code is now executed from the window’s perspective and not from the viewer’s, there are a few changes you must make. Let’s take a look at those.
Identifying an object among all the contained objects

First, just as with the code in initializeObject, this version of dataAvailable must locate the Customer SDO so that it can get the value of the Country field. And in this case, the warning about allowing for multiple Navigation-Targets becomes a reality. By the time this is executed, the other pages in the folder have likely been enabled, and the toolbar now has multiple Navigation-Targets. So you have no choice but to retrieve that value as a list and search through it for the Customer SDO.

Note: If you neglect to do this, you will get the error message, “Field Value too large for Integer,” because the run-time engine tries to convert some string such as 12345, 24356, 45675 into a handle, which is treated internally as a kind of integer.

You could do this by checking the LogicalObjectName property and comparing that to custcommentsv. This seems a little too restrictive, though, since it means that you must edit the code if you ever change the name of the viewer on Page 1. Since the code is checking the value of a field in the Customer table, it seems safer to check for the presence of the Customer table in the SDO, which is in its Tables property.

The code allows for the possibility that the Customer table might be joined to some other table in the SDO, in which case the Tables property would be a list, as shown:

Scoping variables in super procedures

Let us digress to discuss an important point. Once initializeObject has determined the SDO handle, it could stash the handle in a variable defined in the super procedure. Then this code would not have to locate it again.

This is true, but it is also very dangerous. In this example, because the super procedure serves only the oemaintwin window, storing the handle in a variable works fine. The value of the SDO handle would be valid for the life of the window. But what if, under some circumstances, the user can run two copies of the window at the same time? They would both share a single running instance of the super procedure. The value of the SDO handle saved away by one running instance of the window would not be valid for the other running instance. The kind of errors produced by this type of situation can be insidious and difficult to track down.

Or, what if you realize later that another window requires similar support for disabling actions based on a value check? Efficient programming would be copying code from the first one. Start with the existing procedure and take the elements that are subject to change (such as the name of the field and its value). Turn them into parameters or properties of the object. Let the single procedure work for all windows requiring this type of support.
In that scenario, it is likely that two different windows of this kind might be running at the same
time, in which case they would be sharing a single instance of the super procedure, since much
of the purpose of super procedures is to reduce memory use as well as r-code. The moral is that
it is very bad form to hold any values across calls to different methods in a super procedure
unless you are positive that a single instance of the super procedure will never be used to
support two different objects at the same time.

Redirecting the PUBLISH statement from the window

The next step remains the same as before: Get the Country value and reset the cTargets
variable to hold a list of the TableIO-Targets, as shown:

```plaintext
ASSIGN cCountry = DYNAMIC-FUNCTION ('columnValue' IN hDataSource,'Country')
cTargets = DYNAMIC-FUNCTION ('getTableIOTarget' IN hToolbar).
```

Look at the next statement:

```plaintext
PUBLISH 'resetTableIO' FROM TARGET-PROCEDURE.
```

When this code was in the viewer’s super procedure, the TARGET-PROCEDURE was the viewer
itself. But now the code is executing from the window. Rather than going to the trouble of
tracking down the handle of the custcommentsv viewer, it is simpler just to RUN resetTableIO
directly in the toolbar, whose handle you do have, since this has exactly the same effect.
Remember that a PUBLISH statement is basically the same as a RUN statement except that the
procedure handle the event gets run in is not specified in the PUBLISH statement. So you should
change the statement to this:

```plaintext
RUN resetTableIO IN hToolbar.
```

Reasons not to RUN SUPER from the window

The final change is also important to think about for a moment. Ordinarily, you must remember
to include the RUN SUPER statement in your local procedure. Here you must remember to leave
it out! The reason is that the window is not a native subscriber to the dataAvailable event at
all. It just needs to intercept it to take some action on behalf of other objects. For this reason, no
super procedure of the window implements dataAvailable, and if you try to invoke it with a
RUN SUPER statement, you will get an error at run time, much as if you had put in a statement that
said RUN dataAvailable IN <non-existent-handle>.

So, you must remove the RUN SUPER statement as you convert the code to work in the window’s
super procedure, as shown:

```plaintext
/* RUN SUPER (pcRelative). */
END PROCEDURE.
```

In some cases, especially where code is designed to work in a variety of situations, you might
be faced with a case where there might or might not be a super procedure with the event in it.
In this case it is perfectly OK to write RUN SUPER NO-ERROR.
Reasons not to use enableActions and disableActions

You might notice that there are two functions defined for toolbars in the Panel class called enableActions and disableActions. You might be tempted to run those functions directly rather than setting the DisabledActions property the example in this section described. This is generally not a good idea, as these functions are intended for internal use only.

In particular, they are very short-term in their effect. That is, if you use disableActions to disable, say, the Delete action, it will have an immediate effect, but as soon as any operation occurs that resets the toolbar, such as a page change, the action will be enabled again. This is probably not what you want, and this is why it is better to use the DisabledActions property to change the settings until you need to change them again.

Defining action rules for menu and toolbar items

When you define items for a Progress Dynamics menu or toolbar, you can define a set of action rules that determine when the item (that is, the toolbar button or menu item) is enabled, when it is hidden, and when an alternate image for a toolbar button should be displayed. In fact, this capability is now a standard part of the ADM2 code and determines the behavior of all of the standard Navigation, Commit, and TableIO items in SmartPanels and toolbars. The code to support this replaces the setButtons SmartPanel procedure that has been used in earlier versions of the ADM. Application code can still call setButtons, but it is no longer used as a routine part of the action of enabling and disabling buttons and menu items.

An action rule can be an expression containing a combination of SmartObject property references and function references. The expression controls different actions as follows:

- If the expression for the **enable rule** returns TRUE, then the item is enabled; otherwise it is disabled.
- If the expression for the **hide rule** returns TRUE, then the item is hidden, that is, actually removed from the menu or the toolbar; otherwise it is viewed.
- If the expression for the **alternate image rule** returns TRUE, then the alternate image or Image 2 is displayed for a toolbar button; otherwise the primary image (Image 1) is displayed.

These rules are evaluated whenever the state of the toolbar’s window changes in a way that could require a re-evaluation of the rules, for example, on a page change, when a record is selected or navigated to, or when one of the toolbar buttons or menu items is selected.

You can also programmatically force a re-evaluation of a rule. You get a handle of the toolbar and run the resetTargetActions procedure. You can add the following code in your super procedure of your container:

```pascal
{getContainerToolbarSource ctHandles}
DO i = 1 to NUM-ENTRIES(ctHandles):
   hHandle = WIDGET-HANDLE(ENTRY,ctHandles)
   RUN resetTargetActions('myLink') IN hHandle.
END.
```

This code will re-evaluate all rules for items having an item link of **myLink**Target.
You define action rules in the **Toolbar and Menu Designer** as shown in Figure 3–14. If you look at the rules for some existing items, principally in the **Navigation**, **TableIO**, and **Commit** groups, you can see examples of action rules that are defined as a standard part of the framework.

![Figure 3–14: Toolbar and Menu Designer](image)

This figure shows the enable rule for the **First** button or menu item in the **Navigation** group. What it means is that if the query position is either on the last record or on some record that is not first or last, and the window is in a state where the user is allowed to navigate records, then enable the first item.

**QueryPosition** is an SDO property that is set whenever a query is opened and whenever the user selects a record or navigates to a new record. Its values are discussed below, along with other useful properties that are frequently used in action rules.

The **canNavigate** function does a fairly complex analysis of the state of all the objects in the window to determine whether the user should be permitted to move to another record. If an update is pending in a record in the SDO being navigated or in any dependent SDO, for example, then navigation is disabled in the window until the update is completed. This function returns **TRUE** or **FALSE** depending on the state of things, and this helps the toolbar determine whether the navigation buttons should be enabled.

Another example of an **enable rule** is the **Save** button in the **TableIO** group, as shown:

```
NewRecord=add, copy or DataModified
```
Defining action rules for menu and toolbar items

This means that if the **NewRecord** property indicates that there is either an add or a copy in process, or the **Data Modified** property indicates that an existing record has been modified, then enable the **Save** button.

There are no actively used items that have a hide rule, but you can define your own rules to hide unwanted items based on the state of the application at run time.

An example of an alternate image rule is this one for the **Comments** item, as shown:

```
hasActiveComments()
```

This invokes a special function that returns `TRUE` if the current record has an active **Comments** record associated with it. If it does, then it displays its alternate image, a **Comments** button with a check mark on it, so that the user knows that there are comments to view.

Be cautious about modifying the action rules for standard buttons in the framework, since you change their behavior everywhere they are used. However, there are cases where you might want to modify the action rules for standard buttons. For example, if you want to keep the **Save** button enabled at all times and in all places in your application when there is anything updateable in the window, rather than having it enabled only when a user has begun to enter changes into a field, you can do this by altering the action rule for the **Save** button from this:

```
NewRecord=add, copy or DataModified
```

To this:

```
ObjectMode=Update, Modify
```

The **ObjectMode** property of a viewer can be view if it is read-only, update if it can be enabled by pressing a button, or modify if it is always enabled for input. You can force the **Save** button to be always enabled by checking for either **Update** or **Modify** as the **ObjectMode** value.

**Note:** Since menu and toolbar information is cached, it is necessary to clear the cache to notice your changes. You can either restart the session or clear the cache by deleting the persistent procedure `adm2/toolbar.p` using the **Procedure Object** viewer. Make sure that no windows that use a toolbar are open in the AppBuilder when deleting that procedure.
Understanding the role of the item link

It is important to understand where these functions are executed and where property values are retrieved. When you define an item in the Toolbar and Menu Designer, shown in Figure 3–15, you must define an Item link for it.

![Toolbar and Menu Designer: item link definition](image)

Figure 3–15: Toolbar and Menu Designer: item link definition

Any toolbar that uses this item must be a source for that link type in order for the item to be active. The evaluation of the properties and functions in action rules is done in the target for the link. In many cases, the Item Category allows you to define a default value for the Item link that applies to all items in that category unless they specify otherwise.

The Item Link Default for the Navigation category, for example, is Navigation. The Navigation buttons communicate with objects that are Navigation-Targets of the toolbar.

If an action does not have an item link defined and its category also does not have an item link defined, then the event is processed on the toolbar’s container by default.

If there is no default specified for the Category, then you must define an Item link, as shown in Figure 3–16, for the item if it has action rules or if it publishes an event as its action, as the Comments item does.

![Defining an item link](image)

Figure 3–16: Defining an item link

In this case, when you enter the Item link for an individual action, you enter the full link name including the ~Target extension.
Syntax of the action rules

An action rule contains a delimited list of function references and properties that return a logical result. The syntax for rules is as follows:

```
[ property | function ] = list [ AND | OR ] ...
```

A property is the name of a SmartObject property that is retrieved across the specified Item link. If the property is of data type LOGICAL and you want the TRUE value to be used in the expression, then you simply include the name of the property in the rule. For example, DataModified means if DataModified is TRUE. If you want to use the negation of the property in the expression, then you must include it as a value, following an equal sign, as in DataModified=no.

If the property returns some other value, then you specify a value or a comma-separated list of values to match. A property reference with a list of values evaluates to TRUE if the property value matches any value in the list.

A function is the name of an ABL function that is executed across the specified Item link. You can only use functions that return a LOGICAL value. To differentiate a function reference from a property, follow the name of the function with empty parentheses, as in canNavigate().

A rule can be built up from any number of elements, each involving a single property or function. Separate the elements by the AND or OR keyword. Complex expressions requiring grouping of elements with parentheses cannot be used in action rules. If you must perform a calculation complex enough that the action rule syntax is not sufficient for it, then you should define a function of your own in the Item link target that does the calculation and returns TRUE or FALSE, and use it in your action rule.

Properties typically used in action rules

You can use any property or function you want in an action rule, but there are a handful that are most likely to be useful. These are all used in existing action rules in the Navigation, TableIO, and Commit categories. Here are some useful properties:

- **QueryPosition** — This SDO property identifies where in the dataset the cursor is positioned. It is generally used to identify which navigation items to enable. Its possible values are:
  - **FirstRecord** — The first record.
  - **LastRecord** — The last record.
  - **OnlyRecord** — There is only one record in the dataset.
  - **NotFirstOrLast** — The cursor is somewhere in the middle of the dataset.
  - **NoRecordAvailable** — The dataset is empty.
• **RowObjectState** — This SDO property identifies whether a modified record has been saved on the client without being returned to the server. This would normally be true only if there is a Commit-Source (such as toolbar with a band of Commit and Undo buttons) in the window that causes updates to be cached on the client until a Commit event happens. So the Commit and Undo buttons use these two values to determine whether they should be enabled or not:

  - **NoUpdates** — No updates have been saved without being committed (so Commit and Undo buttons should be disabled, for example).
  - **RowUpdated** — At least one record has been saved without being committed (so Commit and Update buttons should be enabled).

• **RecordState** — This property, defined for data visualization SmartObjects, indicates whether there is a record available to display or update. Its possible values are:

  - **RecordAvailable** — There is a record available for display or update.
  - **NoRecordAvailable** — There is no record available for display or update. This normally means that the dataset of the associated SDO is empty. This could be the case, for example, when the user is adding OrderLine records for an Order and the first OrderLine has not yet been added. In this state, the application can allow an Add operation but not an Update or Delete.
  - **NoRecordAvailableExt** — This special value indicates that not only is there no record available in the current dataset, but there is no record available in the parent dataset either (The ext suffix means extended). This is useful information because it signals to an update band that it is not appropriate to enable even an Add operation. For example, if the current SDO is an OrderLine SDO, and there is no currently selected Order (perhaps because the current Customer in the SDO yet another level above has no orders), then it is not appropriate to allow the user to add an OrderLine because there is no Order key to assign to it. This is why the action rule for the Add button is this:

    RecordState=RecordAvailable, NoRecordAvailable and Editable and DataModified=no and CanNavigate()

At first it might not seem sensible to check that the RecordState is either RecordAvailable or NoRecordAvailable, but it is for exactly this reason that this is the case. The one remaining condition is that the RecordState is NoRecordAvailableExt, and in this case the Add button is not enabled.

• **Editable** — This LOGICAL property is defined for data visualization SmartObjects, and it is TRUE if the current target SmartObject is editable, that is, can be used for an Add, Copy, Update, or Delete. This is normally the case if the object has any enabled fields, or if it is a GroupAssign-Source for some other object that has enabled fields.

• **DataModified** — This LOGICAL property is defined for SDOs, and it is TRUE if the current record in the dataset has been modified but not saved. As soon as a user begins to type into an enabled field in a viewer or an enabled cell in a browser, a trigger sets this property to TRUE and notifies the toolbar that is its TableIO-Source. The result is that the Save and Cancel buttons are immediately enabled.
Defining action rules for menu and toolbar items

- **NewRecord** — This property is defined for data visualization SmartObjects. It indicates whether the currently displayed record is a newly created record, that is, one that has not yet been saved back to the database. It is a CHARACTER property rather than a LOGICAL property because it can have three possible values:
  - **No** — For an existing record.
  - **Add** — For a new record created by an Add operation.
  - **Copy** — For a record newly created by a Copy operation.

- **ObjectMode** — This data visualization property is new to the ADM2 with Progress Dynamics. It is used by some of the toolbar types that contain View and Modify buttons that alternate the enabled state of the object, as well as a Save button to actually save changes. Its three possible values are:
  - **Modify** — The object is in Modify mode, with fields enabled but no changes underway.
  - **View** — The object is in View mode, with fields disabled.
  - **Update** — The object is in Save mode, with fields enabled and changes in process, so that the Save button is also enabled to save the changes.

- **FilterActive** — This LOGICAL property is TRUE if there is currently a filter applied to the SDO that is being browsed. This is used, for example, in the alternate image rule for the Filter button itself, to display the image with the check mark. You might also use it to determine whether all data for a table is being retrieved or only a filtered subset of the data.

**Functions typically used in action rules**

There are also several functions that are used in existing rules. Remember that a function used in a rule is identified by its parentheses and must return a LOGICAL value:

- **canNavigate()** — This LOGICAL function determines whether the user should be free to navigate to another record in the dataset (whether by pressing a Navigation button or selecting a record in a browser). The function returns No if an update is in progress and unsaved anywhere within the chain of dependent data objects.

- **hasActiveAudit()** — This LOGICAL function returns TRUE if the current record has one or more active audit records associated with it.

- **hasActiveComment()** — This LOGICAL function returns TRUE if the current record has one or more active comment records associated with it.

**Defining rules that use your own functions and properties**

You can define new properties or functions to use in your own action rules, if existing ones are not sufficient to express the criteria you need to enable and disable, hide and view, or change the image on toolbar items. In particular, if your application logic needs to perform some fairly specific or complex operation to determine the proper state of toolbar items, you might want to define a function that does the calculation and returns TRUE or FALSE accordingly. This is similar to the modifyDisabledActions discussion and example earlier in this chapter.
If you are modifying the behavior of existing buttons, such as the TableIO buttons that are used throughout the framework, it is almost certainly not a good idea to change the definitions of their rules in the Toolbar and Menu Designer. In fact, one of the key points you must keep in mind when you define action rules is that all of the elements of the rule must be available for evaluation anywhere the item is used. If the property or function is not defined, it will be considered to be FALSE, which means for example that an enable rule with such an expression would never be TRUE and the button would never be enabled anywhere in the framework or any application module where it is used.

It is more appropriate to define action rules for new toolbar items you create for your application. Then you can associate whatever properties and functions you need, as long as you are sure they will be available to evaluate wherever the item is used.
Caching Application Data on the Client

Caching certain types of application data on the client improves application performance. This chapter discusses the types of caching provided by the Progress Dynamics® framework and strategies for using the features, as described in the following sections:

- Why cache?
- Data types and cache types
- Mechanics of caching
- Enabling caching for an SDO
- Turning on caching for dynamic lookups and combos in a session
- Enabling caching for a dynamic lookup
- Enabling caching for a dynamic combo
- Using the Dynamic Launcher
- Cache APIs
Why cache?

The frequency of data requests and the amount of data sent across the wire impact the performance of distributed and thin network clients. An application’s performance can be drastically improved if frequently accessed data is cached on the client, allowing the application’s data objects to operate on data in the cache rather than relying on repeated server calls. This approach not only reduces network traffic, but it also decreases the demand on the AppServer’s resources and thereby increases the application’s scalability.

The two most important development issues with caching are:

- Data in the cache becomes stale as the underlying database data changes.
- Too much data in the cache might have a negative impact on performance.

Therefore, caching is most applicable and valuable for data that are frequently used, relatively static, and have low volume. Since there is no generic way to identify data that will most benefit from caching, it is up to you to enable caching for suitable data and thereby improve the overall performance of your application.

Prior to Progress Dynamics Version 2.1B, the framework supported caching features devoted to managing data navigated by dynamic lookups and dynamic combos. Version 2.1B implements a new type of caching at the SmartDataObject level. Dynamic lookups can continue to use the existing lookup-based caching, and this functionality has been enhanced to provide better performance in Version 2.1B. SDO-based caching does not apply to dynamic lookups. Dynamic combos can continue to use the combo-level caching, or they can use the new SDO-level caching.

Note: If you have existing custom code that uses the ADM2 APIs for DynCombo and DynLookup, be aware that these APIs have changed. See Documentation Notes for 10.0B Service Pack 2 for a list of the changes. Progress Software Corporation strongly recommends updating your existing code to use the new APIs as quickly as possible. Also, see OpenEdge Development: Progress Dynamics Administration for related performance information.

Data types and cache types

To understand the caching capabilities of the framework, let’s start with some common definitions. First, here’s a way of categorizing your data to assess its suitability for caching. Categories of data include:

- **System data and administration data** — This is the read-only data that defines your application, such as entities and user preferences. In Progress Dynamics, any caching of this information is handled by the Repository and the framework. This type of data and caching is not covered here. See the chapters on Progress Dynamics managers for more information.
• **Nontransactional data** — Application data that can change on the client. When it does, it is unlikely to affect other data records (for example, records holding descriptive information). This information is a good candidate for Progress Dynamics caching if it meets the following criteria:
  
  – It is infrequently modified.
  – It is frequently accessed.
  – There is a low volume of the data.
  – Loading this data into the cache at application startup does not degrade start-up performance below your required benchmarks.

**Note:** Although the framework caching support makes a somewhat suitable SDO for handling genuinely static data, there are simpler solutions. For example, true constant data, such as a list of weekdays or a list of months, can be defined in widget or object attributes, global variables, external files, hard-coded source and so on. This approach avoids AppServer hits completely.

• **Transactional data** — Data that results from application transactions. Transactional data which is application data found on the client, is not well suited for caching because:
  
  – It has high volume.
  – It might be child data.
  – It might be frequently modified.

  All these reasons mean that the data will change frequently, force frequent updates of the cache, become a performance drain, and thereby defeat the purpose of client-side caching.

There are many types of caching schemes, each with its uses, include:

• **Persistent cache** — Data can be stored on the client side persistently and will be accessible at the client side from session to session. Progress Dynamics does not support persistent caching with SDO-based application data caching. There are cache APIs that will make it easier for you to develop your own persistent caching scheme. See the “Cache APIs” section on page 4–12 for an overview of the available hooks.

• **Session cache** — All data in the cache is destroyed when the session ends. When a new session starts, data needed again is retrieved from the server. The framework cache for client-side application data is a session cache.

• **Timed cache** — Cached data is only valid for a specific time and must be flushed after this time. Either a persistent cache or a session cache can be a timed cache. In Progress Dynamics, you can configure the session cache to be a timed cache or a cache that lasts the entire session.

**Note:** Framework caching or application data is a run time feature. Since no application caching is done in development mode, you’ll need to test your caching schemes during run time.
Mechanics of caching

The SDO is the data-managing interface between the AppServer and your client application. Enabling a cache is like placing a bucket between the AppServer and the SDO, as shown in the following figure:

The result set of the SDO’s query is stored as a temp-table in the cache, and any reference to that SDO forces the SDO to check the cache, find the temp-table, and retrieve the data. When the necessary data is not available or has expired, the cache will get what it needs from the AppServer.

The framework accomplishes this caching not by implementing a true physical cache in memory, but by using the seamless versatility of temp-tables. Since dynamic temp-tables received as a parameter are scoped to the session by default, they are completely capable of being used as a cache. Temp-tables are active, so SDOs can operate directly on cached data. There is no need to duplicate data and no need to synchronize updates with the cache. The cached data can be navigated and browsed independently by multiple instances by utilizing ABL’s ability to define separate buffers on a temp-table.

For SDOs that are defined with statically defined temp-tables, they will not be able to store or use data from the cache as efficiently as dynamic SDOs. A static temp-table is scoped to the procedure that defines it, so it is necessary to either keep the defining procedure running or keep a dynamic copy of the temp-table in the cache. In the cases where an SDO with a static temp-table definition is running on the client session, the static data will be copied to and from the cache.
Cache versus a shared cache

There are two important notions of how the cache should operate when confronted with multiple instances of one SDO. The first notion is *simple caching*. Here, the first instance of an SDO creates a record in the cache, and that record will remain in the cache for the entire session or, optionally, for a specified period of time. Each subsequent instance of the SDO ignores existing cache records and creates its own cache record. This essentially means that each new instance of the SDO will hit the AppServer for its own result set and store it in the cache. This is not a common use case.

Simple caching is enabled and configured with the CacheDuration property of the SDO. This property accepts the following values:

- If it has a value of zero, then simple caching is disabled (the default).
- If it has an INTEGER value greater than zero, then the SDO’s cache becomes a timed cache with a duration equal to the number of seconds specified by the INTEGER. The cache records will be destroyed when two things happen: the last instance using the cache record is destroyed and the amount of time specified expires.

  **Note:** If two instances specify different values for a timed cache, the shortest duration specified is the duration the CacheManager will use.

- If it is set to the Unknown value (?), then the data in the SDO is cached for the life of the session.

The second notion is called *sharing*. If a cache is shared, then the first instance of the SDO will create the cache record, and each subsequent instance will use the data in that cache record. When all instances of the SDO are closed, the cache record is also destroyed. The first new instance of the SDO will create a new cache record.

Shared caching is enabled with the logical Shared property of the SDO:

- If this property is true, then the SDO’s cache is a shared cache.
- If this property is false, then the SDO’s cache is not a shared cache.

  **Note:** When both types of caching are enabled, the caching occurs at the SDO level and the data is shared among all instances. This cache will be valid for the session.

Interaction of the CacheDuration and Shared properties

The most likely use case will be setting both of the properties. When the CacheDuration property is not equal to zero and the Shared property is true, then cache data is shared, but the cache is not cleared when the last instance of an SDO is closed. The cache data will be available when the next instance of the SDO runs.
Normally, with Dynamic SDOs, you would expect both properties to be set. There might be a case for setting CacheDuration and setting Shared to false. It is conceivable that data values might vary due to differences in instances, for example, if a calculated field expression includes external instance data. This is also the only valid cache mode for cases where the static proxy is running on the client, or in sessions with database connections with the full static SDO running on the client.

### Enabling caching for an SDO

The **SmartDataObject Properties** dialog box for an SDO instance allows you to configure caching for an SDO. You use the **Share data** (Shared property) and **Cache data** (CacheDuration property) options to accomplish this.

First, these two options are not available if:

- **Partition** is set to None.
- **Read data in batches** option is selected.

In other words, caching does not make sense if no AppServer partition is available and if the SDO will be batched.

To configure SDO caching:

1. Select an SDO instance, right-click, and choose **Object Properties**. The **SmartDataObject Properties** dialog box appears:

2. Select **Cache data**. SDO data will now be cached for the whole session.

3. (Optional) If you want a timed cache, select **Timed cache** and enter a value for Hours, for minutes, or both.

4. Select **Share data**. Cached SDO data will now be shared among all instances.
Turning on caching for dynamic lookups and combos in a session

You can control whether or not caching is enabled for dynamic combos and lookups on the field-level. To start out, caching of dynamic lookups and dynamic combos is disabled. For each session type where you want to use caching for either or both, you must set a session property on the applicable session type.

Set `field_cache_options` to one of the following values:

- **ALL** — Enables caching for all field types. Currently this is only DynCombo and DynLookup.
- **DynCombo** — Enables caching for DynCombo only.
- **DynLookup** — Enables caching for DynLookup only.
- **DynCombo,DynLookup** — Enables caching for DynCombo and DynLookup.
- **No value** — If this property is not set for a session type, or if the value is blank, then no field-level caching will occur.

**Note:** Caching batched data or child data is not supported by the framework.

Enabling caching for a dynamic lookup

Progress Dynamics supports a type of behind-the-scenes caching for dynamic lookups. The result set of the query for the SmartDataField is kept in one temp-table, and another temp-table manages the subsets of this data being used in each instance of the dynamic lookup. It improves performance by ensuring each instance does not need to store the entire database result set.
To enable caching for a dynamic lookup:

1. Choose Build → SmartDataField Maintenance:

2. Enable the **Use cache** option.

3. Save and exit.

**Enabling caching for a dynamic combo**

The dynamic combo has two caching mechanisms available. The first caching mechanism uses temp-tables to cache data at the SDF level. The dynamic combo allows you to specify an SDO as its data source, and then SDO-level caching is available to the object.

**Enabling SDF-level caching**

Progress Dynamics supports a type of behind-the-scenes caching for dynamic combos. The result set of the database query for the SmartDataField is kept in one temp-table, and another temp-table manages the subsets of this data being used in each instance of the combo. It improves performance by ensuring each instance does not need to store the entire database result set.
Enabling caching for a dynamic combo

To enable this type of caching for a dynamic combo:

1. Choose Build→SmartDataField Maintenance:

2. Make sure the Data source option button has Database query selected.

3. Enable the Use cache option, which is actually enabled by default.

4. Save and exit.

Enabling SDO-level caching

SDO-level caching improves on SDF-level caching in some situations. When the following behavior is desired or improves performance, use SDO-level caching:

- When visual objects that are not combo boxes can also use the data.
- When combo boxes with different list formatting can use the same data.
- When the initial retrieval of data must be done in the same AppServer hit as the rest of the data in the container. (A single lookup in a viewer will negate the reduction of Appserver hits.)
- When you need SDO behavior like calculated fields or temp-table support, and so on.

The main difference with SDO-level caching is that the dynamic combo list (list-item-pairs) must be built each time a dynamic combo is instantiated. SDF-level caching builds this list on the server and caches the list. Each instance then copies the list exactly. Using an SDO-level cache data incurs a slight overhead since it must build the list for each instance at start up.
To set SDO-level caching:

1. Choose **Build** → **Smart Data Field Maintenance**:

2. From the **Data source** radio-set, select **DataObject**. The **Query** section is disabled and the SDF Maintenance tool enables the **DataObject name** field.

   **Note:** When changing an existing dynamic combo from a database query to an SDO, the tool attempts to retain the fields displayed and key field of the dynamic combo. It removes the table name qualifier from the fields displayed and from the key field and attempts to find matching columns in the SDO. If it finds matching columns, it uses those. If it does not find matching columns, it discards the query source data. When changing from an SDO data source to a database query, the tool makes no attempt to retain the fields displayed or the key field of the dynamic combo.

3. Enter the SDO name in the **DataObject name** field. When you enter a valid SDO, the tool updates the field list below to display the columns of the selected SDO. The **Key** field combo box contains the columns of the selected SDO.

4. Unselect the **Use cache** option. For an explanation of what occurs when **Use cache** is enabled with **DataObject** selected, see the next section.

5. Save and exit.
Enabling both

When both types of caching are enabled, the caching occurs at the SDO level and the data is shared among all instances. This cache will be valid for the session. Table 4–1 describes the other valid combinations.

Table 4–1: Caching feature combinations

<table>
<thead>
<tr>
<th>Use Cache</th>
<th>SDO data source</th>
<th>Cache/Shared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>SDO-level cached and shared. Cache duration is 0 (valid for session).</td>
</tr>
<tr>
<td>No</td>
<td>Yes</td>
<td>Shared and not cached. Cache duration is 0.</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>Not cached and not shared.</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>Field-level cached and not shared.</td>
</tr>
</tbody>
</table>

Synching instances

When you change a dynamic combo from a database query data source to an SDO data source, instance overrides of data-related properties might cause the dynamic combo to fail at run time.

Consider the following example: a master dynamic combo has a DisplayedField definition set to “customer.custnum,customer.name”. An instance of the dynamic combo overrides this value with “customer.name,customer.contact”. Changing the master to use an SDO data source changes DisplayedField to “custnum,name”. The instance override of DisplayedField will now fail at run time because the field names are qualified with the table name and should not be.

The Synch Instances button is a tool for removing all overrides of data-related properties in all instances of the SDF. When clicked, it displays the following warning message explaining how it works:

Data-related attributes includes these properties:

- BaseQueryString
- DescSubstitute
- DisplayDataType
- DisplayedField
- DisplayFormat
Caching Application Data on the Client

- KeyDataType
- KeyField
- KeyFormat
- QueryTables
- DataSourceName
- BrowseFieldDataTypes
- BrowseFieldFormats
- BrowseFields

This **Synch Instances** function works with dynamic lookups, too, although its real purpose is to help convert dynamic combos to SDO data sources.

### Using the Dynamic Launcher

The latest version of the Dynamic Launcher has features useful for working with data caching in the development environment.

First, to clear existing data in a cache, enable the **Clear data cache** option before clicking **Run**.

Second, in versions prior to Version 2.1B, the Dynamic Launcher could only launch a single instance. Now, if you enable **Always run new instance**, when you click **Run** again for the same object, Progress Dynamics launches a second instance. This feature is enabled by default:

![Dynamic Launcher](image)

### Cache APIs

The cache interface provides methods to allow dynamic temp-tables to serve as a client cache. It is implemented in `adm2/cache.p`, which is added as a method library to the data class. A call to `getManagerHandle('CacheManager')` in any smart object will return the data class procedure, allowing you to call the cache APIs directly in the data class as if it were a manager. Note that `getManagerHandle` will not return this handle. The cache interface can, however, be extended and implemented as a Progress Dynamics manager with the name ‘CacheManager’. In this case, the ADM2 calls to the cache interface go to the extended manager.
Programming notes

The following information is provided to help you evaluate how the cache can be extended:

- Application data caching is not a generic option for caching temp-tables.
- Caching is configured by enabling it on each SDO you want to cache. The framework does not automatically cache SDO data.
- Cached data should be based on result sets (for example, RowObject temp-tables), not physical database tables.
- Data is cached on demand.
- Cached data can be cleared or refreshed.
- Client-side modifications must synchronize with the cache.
- A modified local cache will not refresh the cache for other users using their own local cache.
- The framework does not support refreshing local caches from the server. To implement this type of feature, you will need message-oriented middleware, like Sonic MQ.

Cache key

All the APIs need a Key to identify the SDO and thereby access the cache associated with that SDO:

- The framework uses the LogicalObjectName of the SDO as the Key to the cache.
- If the LogicalObjectName is not defined, such as when running the code without Progress Dynamics, the framework uses the master filename.

registerCacheItem

Registers the referenced temp-table in the data cache with the passed key as the identifier. Use the key later to reference the item.

**Note:** The assumption is that the table is scoped to the session, as is the case after a call to the server with the table as an output parameter.

**Syntax**

\[
\text{registerCacheItem (Key, Handle, Time, NumRecords, Context)}
\]

**Parameters:**

**Key**

Identifier.
Handle

The temp-table handle to add to the cache.

TimeSpan

Specifies the number of seconds the data in the cache should be considered valid. The framework will pass this from the CacheDuration property on the DataObject.

NumRecords

(Optional) Specifies the number of records in the data.

Context

(Optional) Information needed for the server to refresh the cache.

**findCacheItem**

Returns true if the framework finds an unexpired item with the passed key.

**Syntax**

```plaintext
findCacheItem returns logical (Key, MaxAge)
```

**Parameters:**

- **Key**
  - Identifier.

- **MaxAge**
  - (Optional) Maximum age in seconds. Normally, this value should be shared by all instances of the object, but instances can override it and determine how long to cache data.

**fetchDataFromCache**

This procedure copies data from the cache and returns a table-handle with all the copied data.

**Syntax**

```plaintext
fetchDataFromCache (Key, OUTPUT table-handle)
```

**Parameters:**

- **Key**
  - Identifier.

- **table-handle**
  - The found data returned as a table handle.
createSharedBuffer

Creates a shared buffer from the cache and increments the count of current SDO instances. The framework uses the SDO instance count to correctly track whether or not the data is in use.

Syntax

```
createSharedBuffer returns handle (Key, CurrentBuffer)
```

Parameters:

- **Key**: Identifier.
- **CurrentBuffer**: The current buffer.

destroySharedBuffer

Call this function when you no longer need a shared buffer from the cache. The function decrements the number of instances and deletes the data from the cache if the number of instances is 0.

Syntax

```
destroySharedBuffer returns logical(CurrentBuffer)
```

Parameters:

- **CurrentBuffer**: The buffer you want to remove.

clearCache

Use this function to clear the cache.

A shared cache (active) requires logic to deal with SDO instances running when you clear the cache. Cached, shared temp-tables still in use by at least one instance will not be physically deleted. Instead, they will be marked as dirty. With this scheme, running SDO instances continue to operate. Any new request for data will refresh the cache. The dirty cache will be physically deleted when the last instance that shares its data is destroyed.

Syntax

```
clearCache (Key)
```
Parameters:

Key

Identifier. Supports ‘*’ as a signal to clear all cached data.

Note: A new instance will not share data with old instances that are running with a dirty cache.

Modifying the instance properties

When an SDF uses an SDO as its data source, neither the master nor instance properties of the SDO are available for modification, guaranteeing a fast start up for the dynamic combo. You can, however, programatically alter the SDO instance attributes. The dynamic combo stores the SDO name in the DataSourceName property. With this in hand, you can override the createDataSource() function of the dynamic combo. The createDataSource function starts the SDO as an instance in the container (Viewer) and adds the data link from the SDO to the dynamic combo. The defaults of the available SDO instance properties are shown in Table 4–2.

Table 4–2: Instance properties and defaults of an SDO data source

<table>
<thead>
<tr>
<th>Property</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>RowsToBatch</td>
<td>0</td>
</tr>
<tr>
<td>Shared</td>
<td>True</td>
</tr>
<tr>
<td>CacheDuration</td>
<td>If the dynamic combo’s UseCache property is true, then the Unknown value (?) is the default. This denotes an SDO that uses an untimed session cache. Otherwise, the default is zero, denoting that there is no cache.</td>
</tr>
<tr>
<td></td>
<td>Note: The DynCombo class UseCache property has a default of true.</td>
</tr>
<tr>
<td>DataLogicProcedure</td>
<td>Not used. The framework uses a thin dynamic proxy without a DataLogicProcedure on the client for all SDOs, including static ones.</td>
</tr>
</tbody>
</table>
This chapter provides an overview of the properties and methods of the Application Development Model, Version 2 (ADM2), that are essential to Progress Dynamics application builders. The overview is important so that you can:

- Effectively use the Progress Dynamics framework.
- Quickly distinguish the properties and methods meant for public use from those meant to support the internal workings of the framework or specialized applications.
- Take advantage of useful supporting methods (internal procedures and functions) that you can call directly from your code.
- Understand which methods are typically overridden and which are called directly.

The chapter also provides guidance on how methods are typically used. Some methods are simply internal procedures and functions for you to run from your code. Others are candidates for overriding, meaning that typically you write a local version of the method to extend its behavior and then invoke the standard behavior with a RUN SUPER statement. Another type of method is an event procedure. An event procedure is implemented as an internal procedure that responds to PUBLISH statements in the framework. Event procedures are localized or overridden. This chapter describes the event procedures that are the most likely candidates for localization and provides guidance on how to localize them.
The chapter organizes the information by task, but you are sure to find uses for some of the properties and methods in many other contexts. The following sections describe properties and methods in these task categories:

- **Getting basic information** — Many properties, and some methods, return useful information about objects, their class, whether they are enabled, their contents, and so on.

- **Starting Progress Dynamics application windows** — Understanding the sequence of events that occurs when the framework creates and initializes objects in a container allows you to intercept the process and customize or extend it for your needs. This section describes the relevant methods that you can call and properties that you can set or read to affect application startup.

- **Managing links in Progress Dynamics applications** — This section reviews the properties and methods that the framework uses to manage the links between objects. It also describes how you can use and extend the properties and methods for your applications.

- **Customizing and managing queries** — This section instructs you on the best ways to modify the WHERE clause of a query; determine when it is opened and closed; position and refresh queries; and so on.

- **Paging methods and properties** — A number of properties and methods specifically support multi-page application windows, and this section reviews those.

- **Special functions that manage properties** — Several functions let you define new properties at run time and also return information about standard object properties.

- **General-purpose methods** — The framework provides a few special methods to set and retrieve properties whose values are complex enough that they cannot easily be used directly. This section discusses these methods.

For more information on ADM2 properties and methods, see *OpenEdge Development: ADM Reference*. 
Getting basic information

Properties and methods return useful information about objects, including their classes, whether or not they are enabled, and their contents. This section contains information about the following object functions:

- Object names and types.
- Testing whether objects and fields are enabled.
- Field and widget lists.
- Useful object handles.
- Functions that return field values and attributes.
- Other useful data object functions.

Object names and types

This section describes properties that provide information about types and names.

**ObjectType**

This CHARACTER property, available for all SmartObjects, returns the generic SmartObject class name for the object. For example: SmartWindow™, SmartDataObject, SmartDataViewer, SmartDataBrowser™, SmartDataField, and so on.

**ObjectName**

The **ObjectName** property is the unique instance name of the object for that container, or it defaults to the actual procedure file without path and extension. In the case where an object is used more than once, this can have a numeric digit added to it to distinguish among different instances, or its instance name can be changed by the developer in assembling the container.

**PhysicalObjectName**

This CHARACTER property, available for all SmartObjects, returns the name of the procedure file executed to run the object, including the filename extension, but not including its relative pathname. For a static object, this is the name of the object procedure, such as custviewer.w. For a dynamic object, it returns the name of the driver procedure that instantiates objects of that type. For example, it returns rydynvieww.w for dynamic viewers and rydyncontw.w for dynamic windows, and so on.

**LogicalObjectName**

This CHARACTER property returns the logical name of the object, which is its name as represented in the Repository. For a dynamic object, this is the name the object was given when it was created, either by the Object Generator, or by a developer using the AppBuilder. This property can be blank for objects running without a repository.

For example, it could be custbrowsewin for a dynamic window or customerfullb for a dynamic SmartDataBrowser.
**ContainerType**

This CHARACTER property, available for all SmartObjects, indicates whether the object is a container or not, and if so, what kind of container it is. For noncontainer objects such as Browsers and SDOs, its value is blank. For viewers and SmartFrames™, it returns FRAME. For SmartWindows, it returns WINDOW. For non-visual container objects such as SBOs, it returns VIRTUAL.

**Note:** Remember that SmartDataViewers are considered containers because you can drop field-level objects, such as SmartDataFields, into them.

**QueryObject**

This LOGICAL property, available for all SmartObjects, returns TRUE if the object manages a query. In other words, it returns TRUE for SDOs and SBOs and FALSE for all other standard objects.

**Testing whether objects and fields are enabled**

Your application enables and disables objects, and the fields and widgets they contain, during the course of an application session. The ObjectEnabled and FieldsEnabled properties let you query the current state of the objects, fields, and widgets.

**ObjectEnabled**

This LOGICAL property, available for all visual SmartObjects, returns TRUE if the object itself has been enabled, and FALSE if it has not.

Normally, the framework enables every SmartObject as the application window initializes, unless the DisableOnInit property has been set to TRUE. Compare this property with the similar FieldsEnabled property for viewers and browsers. When the framework initializes a browser or viewer, its ObjectEnabled property is set to TRUE. If it has no enabled columns or fields, however, or if it is in View mode rather than Modify mode, then its FieldsEnabled property is FALSE. Thus the FieldsEnabled property alternates back and forth between TRUE and FALSE depending on the state of the window and the toolbar buttons, while the ObjectEnabled property is normally set to TRUE once and left that way.

**FieldsEnabled**

This LOGICAL property is TRUE when the fields or columns of a viewer or browser are enabled for data entry, and FALSE otherwise.
Field and widget lists

Application code often must identify and get the handles of the fields and other objects inside another object. This section describes some properties that give you that information.

DisplayedFields and FieldHandles

These CHARACTER properties are defined for Datavis objects, that is, SmartObjects that visualize data from a query (normally from an SDO). For a viewer, the DisplayedFields property returns a comma-separated list of all the fields in the viewer that come from the SDO, and the FieldHandles property returns the WIDGET-HANDLE of those fields. The fields can be any type that can display data, including FILL-IN, EDITOR, RADIO-SET, and so on.

The FieldHandles property returns a comma-separated list as well, with each handle converted to a text string. To retrieve the native handle from the list, you must apply the WIDGET-HANDLE ABL function to the appropriate entry in the list. Both lists are always in the same order so that the standard way to get the handle of a field is to look it up in the DisplayedFields list and then locate the corresponding entry in the FieldHandles list. For example:

```
DEFINE VARIABLE cFields AS CHARACTER NO-UNDO.
DEFINE VARIABLE cHandles AS CHARACTER NO-UNDO.
DEFINE VARIABLE iField AS INTEGER NO-UNDO.
DEFINE VARIABLE hField AS HANDLE NO-UNDO.
{get DisplayedFields cFields}.
{get FieldHandles    cHandles}.
iField = LOOKUP('Address', cFields).
IF iField NE 0 THEN
  DO:
    hField = WIDGET-HANDLE(ENTRY(iField, cHandles)).
    MESSAGE hField:SCREEN-VALUE.
  END.
```

This bit of code yields the display shown in Figure 5–1 at run time for the first Customer record.

![Figure 5–1: Customer record message box](image)

In the case of a SmartDataField in a viewer, which is a SmartObject procedure in its own right representing a single field value, the entry in FieldHandles is its procedure handle. The corresponding entry in the DisplayedFields list always points to the field name in the DataSource.
For example, code that manipulates the handle must always check the TYPE attribute, as shown:

```OBJECTIVE-C
DEFINE VARIABLE cFields AS CHARACTER NO-UNDO.
DEFINE VARIABLE cHandles AS CHARACTER NO-UNDO.
DEFINE VARIABLE iField AS INTEGER NO-UNDO.
DEFINE VARIABLE hField AS HANDLE NO-UNDO.

{get DisplayedFields cFields}.
{get FieldHandles cHandles}.
iField = LOOKUP('SalesRep', cFields).
IF iField NE 0 THEN
  hField = WIDGET-HANDLE(ENTRY(iField, cHandles)).
  IF hField:TYPE='Procedure' THEN
    MESSAGE DYNAMIC-FUNCTION('getDataValue' IN hField).
  ELSE MESSAGE hField:SCREEN-VALUE.
END.
```

The SmartDataField supports various internal functions that provide parallels to the properties of ordinary field-level widgets. For more information, see *OpenEdge Development: ADM Reference*.

For a browser, the `DisplayedFields` and `FieldHandles` properties return the list of columns in the browse itself and the handles to the browse cells for those columns.

### EnabledFields and EnabledHandles

These two `CHARACTER` properties correspond to the `DisplayedFields` and `FieldHandles` properties, except that they return only fields or browse cells that are enabled for input.

### AllFieldNames and AllFieldHandles

These `CHARACTER` properties, available for all visual objects (datavis class), return a list of all widgets in the SmartObject’s frame. This list includes the data fields that the `DisplayedFields` property returns as well as all other objects in the frame that are not derived from an SDO. For example, there might be non-SDO fields, along with field labels, rectangles, and buttons. Each of these is a separate widget with its own handle. For the SmartDataField, the procedure handle appears in the handle list.

These properties can be useful if you must manipulate objects in a viewer that are outside the standard field list, such as buttons. You can also use it for visual containers that have no SDO fields, such as a SmartWindow.

Currently, note that for browsers, these properties return the names and handles of the objects in the frame, not the columns in the browser. Thus, just a single name (`brtable`) comes back for the browse widget itself in the `Names` list, and its widget handle in the `Handles` list, along with the names and handles of any other objects that might be in the SmartBrowser’s frame along with the browse control. If you need the column list, you must use the `DisplayedFields` and `FieldHandles` properties.
Useful object handles

The properties described in this section return useful object handles to you.

**ContainerHandle**

This `HANDLE` property, available for all SmartObjects, is only meaningful for objects that have a window or frame. For a frame-based object, such as a browser or viewer, it returns the frame handle. For a window-based object, such as a SmartWindow, it returns the window handle. Use this handle when you must query or manipulate the attributes of the container widget itself.

**BrowseHandle**

This `HANDLE` property returns the browser widget handle for a SmartBrowser. Use this handle when you must query or manipulate the attributes of the browse itself.

**BufferHandles and QueryHandle**

These two properties return handles from the database query that is used to populate an SDO. The `BufferHandle` property is a comma-separated list of the handles of the database record buffers the framework uses to populate the SDO temp-table.

The `QueryHandle` property is the handle of the database query. Note that these handles are the database object handles, not SDO temp-table or buffer handles. They are valid only on the server side of a divided SDO, and should be used only in cases where your code must reference the database data as the framework loads it into the temp-table.

**QueryRowObject**

This `HANDLE` property returns the buffer handle to the SDO’s temp-table buffer (the `RowObject` buffer in other words) that holds the data values for the currently selected row in a browser. This can be useful when you must query those values within the `ROW-DISPLAY` trigger for the browser, for example. The `SCREEN-VALUES` of the individual cells cannot be queried within this ABL event, so in order to write logic that reacts to a cell’s value, by changing the background color or some other attribute of the cell or the row, you must be able to refer back to the underlying data buffer and its fields. See Chapter 1, “Writing Super Procedures for Objects” for more information.

Note that the `WIDGET-HANDLE` is implemented to hide this complexity.
As an example, look at this code from the widgetValue function that is part of the proposed client-side API for retrieving and setting values in dynamic objects from custom super procedures. The variable hField holds the handle to a field from the FieldHandles list, as shown:

```abl
IF CAN-QUERY(hField, "FILE-NAME") THEN
    /* This is a SmartDataField. Return its DataValue property. */
    Note that this is the underlying "key" value that is meaningful to the code, not the "DisplayValue" shown to the user. */
    {get DataValue cValue hField}.
ELSE IF CAN-QUERY(hField, "SCREEN-VALUE") THEN
    cValue = hField:SCREEN-VALUE.
ELSE DO:
    {get QueryRowObject hBuffer} NO-ERROR.
    IF VALID-HANDLE(hBuffer) THEN
        ASSIGN hField = hBuffer:BUFFER-FIELD(cField)
        cValue = STRING(hField:BUFFER-VALUE) NO-ERROR.
    END. /* END ELSE DO IF NOT CAN-QUERY SCREEN-VALUE (Browse) */
```

### Functions that return field values and attributes

The Query class that supports SDOs provides a large number of functions that you can use to retrieve data values and the properties of those fields.

#### column<attribute> functions

There is a whole set of functions that return individual ABL attributes from fields in a data object (one for which the QueryObject property is TRUE, basically SDOs or SBOs).

These functions are located in an adjunct SDO super procedure called dataextcols.p. Both the query class and the data class have enough supporting functions that the code to support them causes compilation problems in older versions of ABL. So the get and set functions for properties are in separate super procedures called queryext.p and dataext.p, respectively. In addition, the dataextcols.p procedure supports all these special column attribute functions. These are all run along with the standard super procedures query.p and data.p and made part of the super procedure stack.

These functions return values in the appropriate data type for the attribute. All the functions have names of `column` plus the attribute name. The prefix, `column`, is not entirely appropriate here, because these return field values from the current row in the SDO buffer, not browse column values.

They take a single input parameter, which is the name of the field. This can be:

- A simple SDO field name.
- A field name qualified by RowObject.
- A field name qualified by the database table it is derived from.
Column attribute functions include:

- **columnColumnLabel** — Returns the Column-Label of the field. Note the word column does appear twice in the function name.
- **columnDataType** — Returns the data type of the underlying database field represented by this column.
- **columnDBColumn** — Returns the name of the column in the database, in case it has been renamed in the SDO.
- **columnDBName** — Returns the name of the database that the field is derived from.
- **columnHandle** — Returns the handle of the field in the RowObject buffer.
- **columnHelp** — Returns the value of the field’s Help text.
- **columnInitial** — Returns the field’s initial value.
- **columnLabel** — Returns the field’s label.
- **columnModified** — Returns a LOGICAL flag indicating whether the field has been modified since it was read into the RowObject table.
- **columnPrivateData** — Returns the ABL Private-Data attribute of a specified column.
- **columnTable** — Returns the name of the database table the column is derived from. It is qualified according to how the SDO is defined.
- **columnWidth** — Returns the width in characters.

There are also equivalent **assignColumn<attribute>** functions for most of these, which take the field name and the attribute value as input parameters.

There are also a few more specialized column functions that are useful.

**columnQuerySelection**

This CHARACTER function, supported for data objects, takes a column name as input and returns a CHR(1)-delimited string with all operators and values that have been added to the query for this field using the assignQuerySelection method (described later in this chapter). For example, if the query contains custnum > 5 and custnum < 9, this function returns >|5|<|9 (where CHR(1) is shown as |). Use this function to do analysis on the current query or to display information to the user.

**columnValue**

This CHARACTER function, supported for data objects, takes the name of the field as input and returns its value, in character form, but without any formatting characters added. This is equivalent to applying the STRING function to the BUFFER-VALUE of the field.

**columnStringValue**

This CHARACTER function, supported for data objects, takes the name of the field as input and returns its STRING-VALUE, which is the fully formatted value as it would appear on the screen (so it is the buffer equivalent to the SCREEN-VALUE of a displayed field or browse column).
colValues

This CHARACTER function, supported for data objects, takes as input a comma-separated list of field names in an SDO and returns a CHR(1)-delimited list of the formatted values (STRING-VALUES, in effect) for those columns for the current row, preceded by a string called the RowIdent that holds the database RowID of the record the columns are derived from. If the SDO involves a join, then this first RowIdent entry in the list is itself a comma-separated list of the RowID values for the records in the join. This is the standard function used internally by viewers in particular to retrieve the values to display as the SCREEN-VALUES of the fields in the viewer.

Note that because the RowIdent is always the first entry in the CHR(1)-delimited list, your code must always look for the value for a column that was in the n-th position in the input list, in the n+1th position in the return value.

This function can be useful for retrieving multiple values at a time, but the columnValue and columnStringValue functions were designed for application use as a more convenient way to retrieve individual values at a time.

colStringValue

This CHARACTER function provides an alternative to colValues as a way to retrieve multiple values in a single call, and with flexible formatting. It does not return the RowIdent of the database records as colValues does. The function takes three INPUT parameters:

- pcColumnList — This is a comma-delimited list of RowObject column names to return values for.
- pcFormatOption — This parameter allows you to specify the format of returned values. It can be:
  - Blank or ? — No formatting is done; unformatted buffer values are returned.
  - Formatted — Returned values are formatted according to the columnFormat with right-justified numeric values.
  - TrimNumeric — Returned values are formatted according to the columnFormat with left-justified numeric values.
- pcDelimiter — This optional parameter specifies a delimiter between values; the default delimiter is CHR(1).

Other useful data object functions

The following additional functions are supported for SDOs, including functions that return index information and functions that retrieve logic procedures.

indexInformation

This CHARACTER function is supported for SDOs. It returns index information for all the buffers in an SDO’s query. The indexes are separated by CHR(1). Field information is either qualified with the database and table name or CHR(2) is used as the table separator.
The **INPUT** parameters for this function are:

- **pcQuery** — This parameter indicates what information is needed:
  - **All** — All indexed fields.
  - **Standard or ''** — All indexed fields excluding word indexes.
  - **Word** — Word indexes.
  - **Unique** — Unique indexes.
  - **NonUnique** — Non-unique indexes.
  - **Primary** — Primary index.
  - **Info** — (Meaningless if **pcIndexInfo** has a value ?).

- **plUseTableSep** — This **LOGICAL** parameter indicates whether the information should be returned using a special table separator. If this parameter is **TRUE** then the data is returned with **CHR(1)** as the separator between indexes an Unknown value (?), then the returned field names are qualified; otherwise they remain as they are in **pcIndexInfo**.

- **pcIndexInfo** — This **CHARACTER** parameter is either a signal to use the SDO query or a string of previously retrieved information. If the parameter has the Unknown value (?), then the function uses the query as the basis for returning information. In this case, if the **plUseTableSep** parameter is **TRUE**, then the field is returned with **CHR(1)** and **CHR(2)** qualifiers. Otherwise this parameter must be the index information in the **exact same format** as was returned from this same function in a previous call with the syntax **indexInformation('info', TRUE, ?)**. In addition, there is a parallel **IndexInformation** property that allows the function to be used with no database connection, or without forcing a call from client to server to retrieve information. The property value is set in the client SDO when it is initialized, so its value is always available on the client. You can use the value of the **IndexInformation** property as the **INPUT** **pcIndexInfo** parameter value to this function, in which case the function acts as a filtering and formatting mechanism to return to you just the information you need, in an appropriate format.

**dataLogicProcedure, dataLogicObject**

Use these SDO functions to retrieve the name of the SDO’s logic procedure, or its procedure handle, respectively.

---

**Starting Progress Dynamics application windows**

For a static SmartWindow, the AppBuilder generates a procedure called **adm-create-objects** to create all the objects at run time. In Progress Dynamics where most windows are dynamic objects, one dynamic window procedure, **rydyncontw.w**, has an empty version of **adm-create-objects** that acts like a placeholder. The procedure calls to create the window and its contents are executed at run time rather than being pregenerated into a source code file. The sequence of steps and the procedures that run are the same as for static windows.
The `adm-create-objects` procedure retains the older naming style of `adm-` plus a procedure name from an older version of the ADM. The reason for this is that in static windows, we need to allow for the AppBuilder-generated code, which the developer should not edit directly, plus a possible local override procedure that can do additional work when objects are created. Because these are both in the same source procedure in a static environment, they must have different names.

As a result, the actual ADM event that is run in a container and published in any child containers is `createobjects`. The standard code for `createobjects`, found in the super procedure `container.p`, runs `adm-create-objects`, which executes the AppBuilder-generated code for a static window. If the developer wants to write custom code for this stage of the application, this goes into a local version of the `createobjects` procedure, as shown:

*Procedure createobjects:*

Parameters:  <none>
Candidate for: localization
See below for information on creating a local version of `createobjects`

Here is an excerpt from an AppBuilder-generated `adm-create-objects` procedure that serves as a model for running some of the same support procedures in your own code:

```pado
PROCEDURE adm-create-objects:
/*--------------------------------------------------------------
Purpose:
Create handles for all Smartobjects used in this procedure.
After Smartobjects are initialized, then SmartLinks are added.
Parameters:  <none>
----------------------------------------------------------------*/
DEFINE VARIABLE currentPage  AS INTEGER NO-UNDO.
ASSIGN currentPage = getCurrentPage().
CASE currentPage:
  WHEN 0 THEN DO:
    RUN constructObject (  
      INPUT  'adm2/pnavlbl.w':U ,  
      INPUT  FRAME fMain:HANDLE ,  
      INPUT  'EdgePixels_2_PanelType_Nav-Label_HideOnInit_no_DisableOnInit_no_ObjectLayou t_':U ,  
      OUTPUT h_pnavlbl ).
    RUN repositionObject IN h_pnavlbl ( 1.71 , 22.00 ) NO-ERROR.
    RUN resizeObject IN h_pnavlbl ( 1.76 , 34.00 ) NO-ERROR.
    ...
```

(1 of 2)
Starting Progress Dynamics application windows

The static adm-create-objects procedure, or the createobjects code for dynamic windows, does several things. First, for each SmartObject in the container, it runs constructObject, which takes the SmartObject procedure name, its parent Frame handle, and its list of instance property settings as INPUT parameters, and returns the procedure handle of the new SmartObject as an OUTPUT parameter. The constructObject procedure runs the SmartObject as a persistent procedure, parents its default frame (if any) to the frame handle passed in, and runs the set<property> function for each instance property name/value pair passed in. Instance properties are SmartObject properties for which initial values can be defined for a particular instance of the object as used in some container.
These properties can be set in the **Instance Property** dialog box of the SmartObject as the container is assembled, and they are initialized in the following example:

```plaintext
Procedure constructObject:
Parameters:
  (INPUT pcProcName /* CHARACTER -- SmartObject name */,
   INPUT phParent /* HANDLE -- parent Frame handle */,
   INPUT pcPropList /* CHARACTER -- Instance Properties */,
   OUTPUT phObject /* HANDLE -- new procedure handle */).
Candidate for: calling
You can call constructObject from your own code to create additional objects in a window at runtime based on application-specific or user-specific factors.
```

The procedure handle of the new SmartObject instance is returned to `adm-create-objects`, which uses it in several other procedure calls.

For any SmartObject with a visualization, `repositionObject` is run to position it at run time. Also, for any object that is resizable, `resizeObject` is run to size the object appropriately. The presence of the `resizeObject` procedure in the object (or its super procedures) determines whether it should be made resizable. In Progress Dynamics, of course, object positions and sizes are not fixed at design time. The layout manager determines the sizes and relative positions of objects based on the overall window size and on which objects are resizable. But you can use these procedures where needed in your code to adjust sizes and position, as shown:

```plaintext
Procedure repositionObject:
Parameters:
  (INPUT pdRow /* DECIMAL – Row number */,
   INPUT pdCol /* DECIMAL – Column number */).
Candidate for: calling
You could run repositionObject from your code to adjust default object positions or to position objects you created outside the window definition stored in the Repository, as shown:

Procedure resizeObject:
Parameters:
  (INPUT pd_height /* DECIMAL – height in Rows*/,
   INPUT pd_width /* DECIMAL – width in Characters */).
Candidate for: calling
You could resize an object based on application requirements, or to make adjustments outside the standard layout manager support.

Once all the SmartObjects have been created, any SmartLinks between those objects are defined. Use the `addLink` procedure to do this. This is described in the "Managing links in Progress Dynamics applications" section on page 5–23.
The AppBuilder also generates calls to `adjustTabOrder` to assure that the tabbing order between SmartObjects is either left-to-right/top-to-bottom (the default), or as reset by the developer in the AppBuilder, as shown:

```plaintext
Procedure adjustTabOrder:
Parameters:
  (INPUT phObject /* HANDLE – object to re-order */,
   INPUT phAnchor /* HANDLE – object to re-order relative to */,
   INPUT pcPosition /* CHARACTER – move "BEFORE" or "AFTER"*/).
Candidate for: calling
  Your code can adjust tab order based on user preferences or application specific requirements.
```

There are two additional properties that are used in Progress Dynamics to size objects proportionally in dynamic windows, `resizeHorizontal` and `resizeVertical`. The LOGICAL properties indicate whether a visual object can be resized in one dimension or the other or both when the window is initially sized, or when it is resized by a user. The properties are defined for all visual objects and have the default values shown in Table 5–1.

<table>
<thead>
<tr>
<th>Object</th>
<th>resizeHorizontal properties</th>
<th>resizeVertical properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viewer</td>
<td>FALSE</td>
<td>FALSE</td>
</tr>
<tr>
<td>Browser</td>
<td>TRUE</td>
<td>TRUE</td>
</tr>
<tr>
<td>Window</td>
<td>TRUE</td>
<td>TRUE</td>
</tr>
<tr>
<td>Toolbar</td>
<td>TRUE</td>
<td>FALSE</td>
</tr>
</tbody>
</table>

Note that you can override these default values. You can set these properties for individual objects to change the default resizing, for example, if you want a browser to be a fixed size in one or both dimensions.

You can set these properties in the Container Builder in the instance section of the main window.

Now, when you run the Customer browse window, the browser is a fixed height, as you can see in Figure 5–2.

![Customer Selection window](image)
The `createobjects` and `adm-create-objects` procedures are part of a sequence that occurs when a container is run. It's important to know the steps in this sequence and where the appropriate places are to put custom application code.

When you run SmartObject code from `constructObject`, any code in its main block is executed first. Custom code that should be executed as soon as the object is run, before anything else happens, can be placed in the main block. Remember that at this time the object has no links to other objects, so you cannot refer to its Data-Source or other such connections; its instance property values also are not yet set, so you cannot refer to them. If you try to set them, the values set by the container override your settings. If you create static objects and need code to be executed immediately when the object is run, you can put it in the main block (this is true for any persistent procedure). If you're using dynamic objects, then you'll have to write a super procedure where you override standard procedures or respond to events.

For the remainder of this chapter, assume that any references to local application code should be taken to mean either code written in a static SmartObject procedure or (preferably in most cases) code written into a custom super procedure for a dynamic object.

Custom code for a window that must reference its contained SmartObjects as soon as they are created should go into a local `createobjects` procedure. If you look at the same `adm-create-objects` procedure above, note that it references the `CurrentPage` property, and then executes a block of a `CASE` statement depending on the current page number. When the window is first run, its `CurrentPage` is zero. As each additional page (if any) is first referenced, `createobjects` and `adm-create-objects` are run again to create the objects on that page.

If you define a local `createObjects` procedure, remember that it runs multiple times if the window has more than just the default page zero, so check the `ObjectCreated` property. It will be false the first time and true on each subsequent call. You can also check the `CurrentPage` property in the same way that `adm-create-objects` does. Each `CASE` should contain a `RUN SUPER` statement to invoke the code in `adm-create-objects` for that page, with the custom code added either before or after that statement, as appropriate.

Code that must do something immediately before the objects on a page are created can be placed in `createobjects` before the `RUN SUPER` statement for that page. Code that must be executed after the objects are created (which seems more likely, since, of course, you cannot access the objects on a page before they are run) must be written after the `RUN SUPER` statement for that `CASE`. For example, a `createObjects` procedure can add additional links between objects that have just been created (based on dynamic application requirements); or it can set additional property values that are not instance properties or that must be set conditionally based on application requirements; it might reposition or reorder objects; or other such things. At this point in the window’s life, all the objects on the current page have been created, positioned, and resized; their frame handles have been parented to the window’s frame; their instance property values have been set; and their links and tab order have been established. But they have not been initialized; that is, the `initializeObject` event procedure has not been run, so visual objects have not been viewed or enabled; queries have not been opened, and so on.
Initializing SmartObjects

You start a SmartObject application in two major steps. Creating the object instance is the first of those steps. This section describes the second step.

Once createObject is done, the window publishes initializeObject, which cascades down as an event to all its children (and their children if any, recursively) and then initializes the window itself, as shown:

```plaintext
Procedure initializeObject:
  Parameters: <none>
Candidate for: localization
  Application code often must extend what happens at startup by localizing the initializeObject procedure. If your code is creating objects the framework doesn't manage for you, then the code will also need to run initializeObject in them.
```

Each type of SmartObject does its own initialization, and then passes control up the stack of super procedures with a RUN SUPER. Among the major events that happen along the way are described in the sections that follow.

The initialization runs enableObject unless it is instructed not to, that is, unless the DisableOnInit property is set to TRUE, which is not its default. It then runs viewObject unless instructed not to by setting the HideOnInit property, whose default value is also FALSE.

enableObject enables any handles in the SmartObject that are not associated with fields from an SDO (these could be extra developer-defined fill-in fields and so on). It sets the ObjectEnabled property to YES. It also runs the procedure enable_UI for AppBuilder-generated objects; this is not something you would write or change yourself. Its counterpart for disabling an object is the event procedure disableObject, as shown:

```plaintext
Procedure enableObject/disableObject:
  Parameters: <none>
Candidate for: localization and calling
  If there is extra work to do when the SmartObject is enabled or disabled, you can do this by creating a local version of the procedure.
  If code needs to enable an object explicitly at the appropriate time, your code may run enableObject or disableObject directly. For example, enableObject must be run for an object by application code if its DisableOnInit Property was initially set to YES.
```
The `viewObject` event procedure is actually run for every type of SmartObject, including nonvisual ones, since the concept of being viewed (which sets the `ObjectHidden` property to `FALSE`) is used essentially as a synonym for active for SmartObjects. For this reason it is supported for all SmartObjects, along with its counterpart, the procedure `hideObject`. The `viewObject` procedure actually views the object’s default frame if it has one, sets the `ObjectHidden` property to `NO` and publishes the `linkState` event with a parameter of active to signal to other objects, such as SmartPanels and toolbars, that they are now active (so buttons should be enabled that were disabled when the target object was hidden by `hideObject`, and `linkState` was published with `inactive`), as shown:

```
Procedure viewObject/hideObject:
    Parameters: <none>
    Candidate for localization and calling
    If there is extra work to do when the SmartObject is viewed or hidden, you could write a local override of the procedure.
    If code needs to view or hide an object explicitly at the appropriate time, then your code could run the procedure directly. For example, `viewObject` must be run for an object by application code if its `HideOnInit` Property was initially set to `YES`.
```

The initialization sequence then runs `displayobjects` to display any nondatabase fields that can be defined. The `displayobjects` event procedure displays the values of any fields or other basic objects in a visual SmartObject that are not associated with SDO fields. It is run here during initialization, as shown:

```
Procedure displayobjects:
    Parameters: <none>
    Candidate for calling
    If the values of non-data fields need be refreshed other than when a record is displayed in the object, then your code might call `displayobjects` to do this.
```

The initialization sequence then runs `enableFields`, if appropriate (if there is a TableIO-Source in Save mode, which allows updates to be entered into the viewer’s fields at any time). Then it runs `dataAvailable` to see if there is a row in the Data-Source waiting to be displayed.

The `enableFields` event procedure enables those viewer fields or browser columns that are associated with SDO data fields (using the `EnabledHandles` property), setting their SENSITIVE attribute to `YES`. (Editors have their READ-ONLY attribute set to `NO`; they are always left SENSITIVE to allow them to be scrolled.) The `FieldsEnabled` property is set to `YES`, and the `enableFields` event is published to send it on to any contained SmartObjects.

The counterpart to `enableFields` for disabling data fields is the event procedure `disableFields`, as shown:

```
Procedure enableFields/disableFields:
    Parameters: <none>
    Candidate for: localization and calling
    If additional code is needed for an object each time its fields are enabled or disabled, you could create a local version of the procedure.
    If data-related fields need to be enabled or disabled when it doesn't happen by default, then code could call the enable or disable procedure directly.
```
The `dataAvailable` event procedure is run each time a new (different) row is positioned to in the SDO query, and when an `update` completes. In the case of `initializeObject`, it is run to catch the case where the Data-Source might have been initialized first and has already published the event before the viewer was ready to. For visual SmartObjects it causes the field values for the newly selected row to be displayed.

For data objects, such as SDOs, it is passed on to a child SDO in a parent-child (master-detail) relationship when the parent SDO moves to a different row. In this case it causes the child SDO’s query to be re-prepared with the foreign key values from the parent row, and the query to be reopened, as shown:

```plaintext
Procedure dataAvailable:
Parameters: pcRelative AS CHARACTER
Candidate for: localization
If additional code is needed for an object each time a different row is selected, this could be done in a local version of dataAvailable.
```

The `pcRelative` parameter to `dataAvailable` can have these values:

- **Different** — This value indicates that a different row in the SDO query has been positioned to. Viewers and browsers will display that row, and dependent SDOs will reopen their queries based on the key values from the new row.

- **"?"** — The Unknown value (?) indicates that it is not known whether or not there is a new row (when called from `initializeObject`, for instance).

- **SAME** — This value signals that the current row has been updated. A viewer or browser will display the row’s new values, but a dependent query object will not bother to reopen its query just because field values have changed in its parent.

- **RESET** — This value causes the procedure to check whether the foreign values for the SDO’s `ForeignFields` key values have changed since the last call do `dataAvailable`. If so, then a dependent SDO reopens its query accordingly. If not, it does nothing. This parameter value in effect combines the behavior of the `SAME` and `DIFFERENT` values, checking intelligently to see which is the case. It is therefore the most efficient value to pass when it is not always known if a new record with a new set of key values is present.

- **FIRST, NEXT, PREV, LAST** — These values signal repositions within a SmartDataBrowser to coordinate with an associated SmartPanel.

The `openQuery` function opens the database query and populates the SDO’s `RowObject` temp-table with the first batch of rows from the database. First it runs the `closeQuery` function if the query has previously been opened. Then it runs the `prepareQuery` function to re-prepare the query if the `QueryString` property has been set (described in a later section). If the SDO is divided between client and AppServer, the client side invokes `openQuery` on the server to open the actual database query.

It then runs the `fetchFirst` procedure to populate the temp-table and position to the first row. `fetchFirst` runs the `sendRows` procedure, which has both a client and server version, to request the first batch of rows.
Finally, `fetchFirst` on the client side sets the `QueryPosition` property to `FIRST` and then publishes the `dataAvailable` event with an argument of `FIRST` to cause client-side objects to display the first row, as shown:

```plaintext
Function openQuery:
  Parameters: <none>
  Candidate for: calling
  If the application has prepared a new query definition with a different where clause, or if the application wants to refresh the current query with the latest data, then code can call openQuery directly.
```

The `closeQuery` function closes both the (client-side) RowObject temp-table query, emptying the temp-table, and also the (server-side) database query. It publishes `dataAvailable` to cause any Data-Targets to erase the current record display (or to close a dependent query if there is one). Your code does not normally call `closeQuery` directly.

The `prepareQuery` function prepares a new query if it has been modified by the functions used to change the where clause. It is intended to be run only internally on the server. Developers should use the functions described in the section on customizing queries, which in turn invoke this function at the proper time.

The `fetchFirst` procedure, along with `fetchNext`, `fetchPrev`, and `fetchLast`, repositions the RowObject query to the corresponding row. These procedures also request a new batch of rows from the database, if needed. They reset the `QueryPosition` property to the appropriate value (`'FirstRecord'`, `'LastRecord'`, `'OnlyRecord'`, or `'NotFirstOrLast'`), and publish `dataAvailable` to alert other objects that there is a different row to display or open a dependent query with. As described, `fetchFirst` is run from `openQuery`.

Otherwise, the four procedures are normally published from a Navigation toolbar band when the corresponding navigation button is, as shown:

```plaintext
Procedure fetchFirst/fetchNext/fetchPrev/fetchLast:
  Parameters: <none>
  Candidate for: calling
  If repositioning other than from a toolbar is needed, then code could possibly run these procedures directly
```

The `sendRows` procedure (along with its two subprocedures `clientSendRows` and `serverSendRows`) transfers batches of rows from server to client. Your code should not normally run this directly.
The dataAvailable procedure in a data display (Datavis) object such as a viewer or browser runs displayFields, which takes as its input parameter a list of values in the form returned by the colValues function, and moves them into the screen values of the viewer or browser. The displayFields procedure also runs displayObjects to display any nondata-related fields, as shown:

```
Procedure displayFields:
  Parameters: pcValueList (CHR(1)-delimited list of values preceded by the RowIdent
  Candidate for: localization
    If application code needs to adjust values before they are displayed or do something else each time a row is displayed, you can do this in a local displayFields.
```

Other methods related to startup and shutdown

The following event procedures are also related to starting up and shutting down SDOs.

**destroyObject**

This is the standard event procedure that runs to shut down an object. It deletes links properly and performs other cleanup tasks before deleting its own persistent procedure, as shown:

```
Procedure destroyObject:
  Parameters: <none>
  Candidate for: localization
    If application code needs to do other work just before an object is destroyed, it can be done before the RUN SUPER statement in a local version of destroyObject.
```

**exitObject**

For an application window to shut down properly, its objects should be deleted from the inside out. That is, the contained objects must clean up and delete themselves before the window itself is deleted. An event such as pressing a **Done** or **Exit** button inside a container can initiate this by publishing the exitObject event. The convention is that the event passes the exit request to its Container-Source. The container that can initiate the exit defines a local version and does not call the standard one.

That local exitObject is built into the SmartWindow support code, as shown:

```
Procedure exitObject:
  Parameters: <none>
  Candidate for: calling and possibly localization
    Any button or other object inside a container that wants to close the container should run exitObject in its immediate container (a viewer for example).
    If application code needs to do other work just before a window is destroyed, it can be done before the RUN SUPER statement in a local version of exitObject.
```
launchFolderWindow

This procedure runs routinely from a dynamic browser when the user double-clicks on a row or selects the Edit or Modify button. It retrieves the value of the FolderWindowToLaunch property for the browser, which is part of the browser definition, and invokes the launchContainer procedure in the Session Manager. For more information on launchContainer and examples of its use, see Chapter 5, “Using ADM2 Properties and Methods.”

Because launchFolderWindow is specifically intended to be invoked inside a browser, you normally use the launchContainer procedure itself when you want to invoke containers from your application code.

Other initialization properties

This section describes properties that are related to starting objects.

HideOnInit

This LOGICAL property is defined for all visual objects and has a default value of FALSE. If your initialization code sets it to TRUE for an object before the object is initialized, then that object is initially hidden when it is created. This is an example of a property you can set from a local version of createobjects, after the objects on a page have been created but before their initializeObject code is run.

If you set HideOnInit for an object, then you must run viewObject when you want it to appear.

DisableOnInit

This LOGICAL property is defined for all visual objects and has a default value of FALSE. If your initialization code sets it to TRUE for an object before the object is initialized, then that object is initially disabled when it is created. This is another example of a property that you can set from a local version of createobjects, after the objects on a page have been created but before their initializeObject code is run.

If you set DisableOnInit for an object, then you must run enableObject when you want it to appear.

ObjectInitialized

This LOGICAL property is set to TRUE when the object’s initializeObject procedure has been run. You should not set it yourself, but you can check its value to determine whether an object has already been initialized, to avoid running custom initialization code a second time, for example.

OpenOnInit

This LOGICAL property is defined for data objects whose QueryObject property is TRUE and has a default value of TRUE. If you set the value to FALSE before the object is initialized, then its query does not open and its temp-table is not populated. If you want the user to enter filter data to reduce the size of the dataset before any rows are returned, you can set the OpenOnInit property to FALSE. In this case the application does not needlessly open the query, populate the temp-table, and return the table to the client simply to display the first rows in the table, which the user might not want to see. This is another property that you can set in a local createobjects.
FolderWindowToLaunch

This CHARACTER property is defined for dynamic browsers. When you define a dynamic browser you can use FolderWindowToLaunch to specify the maintenance window to launch when the user selects a row in the browser. Note that the Folder Window To Launch property does not actually have to be a window with a folder in it. It *does* need to be a window that expects to receive a key value from the calling window, so that the child window can display the data for that row.

Figure 5–3 shows the AppBuilder property sheet for the dynamic browser, where you can set this property.

![Property sheet for dynamic browser](image)

Figure 5–3: Property sheet for dynamic browser

Your code could also programmatically set this property value at run time if the child window to launch depends on some application particulars.

Managing links in Progress Dynamics applications

This section describes the following properties and functions that support the ADM SmartLink mechanism:

- SupportedLinks property and the addLink procedure.
- Defining custom SmartLinks and events.
- Link support methods.
SupportedLinks property and the addLink procedure

There are standard links associated with each SmartObject class. The SupportedLinks ADM property for the class names these links. Each link is defined with a set of ADM property values and functions to support getting and setting those properties and are described in this section.

SmartLinks are established when a SmartObject is created at run time, when the createobjects procedure runs addLink. All these supporting elements are already present for all of the standard shipped SmartObjects. This description is here to help developers understand how the ADM link mechanism works and how it can be extended for new SmartObject types.

SmartLinks are typically established when you define links in the Container Builder while assembling SmartWindows or other containers. When you define a template container in the Container Builder, you also define links between the objects in the template. When you define a specific window using that template, you can add additional links. For example, you can add a link that connects objects on different pages that you assemble. For each link, a record is added to the Repository to define the link. At run time, the dynamic window procedure runs addLink to create those links, as shown:

```
PROCEDURE addLink:
Parameters:
   (INPUT phSource /* HANDLE – Source procedure handle */,
    INPUT pcLink   /* CHARACTER – Link name */,
    INPUT phTarget /* HANDLE – Target procedure handle */).
Candidate for: calling
   If you need to create your own additional links at runtime based on application requirements, you do this by running addLink.
```

The addLink procedure requires that three basic properties and supporting functions for those properties be predefined in the SmartObject support files (its include files and super procedures). In the source procedure for the link, there must be a property that holds the handle or handles of the targets for each supported link. In the target for the link, there must be a property that holds the handle or handles of the link source for each supported link. These source and target procedures use functions that set property values in linked SmartObjects or return the handles of those linked objects when needed. At startup time, addLink sets these properties to the appropriate procedure handles. The names of the properties must be `<LinkType>Target` in the source SmartObject, and `<LinkType>Source` in the target object.

In addition, addLink requires that a property must be in the target SmartObject listing the events that the target object wants to be notified of when those events are published by the source. The name of this property must be `<LinkType>SourceEvents`, and must be a comma-separated list of event names. If the source of the link also wants to be notified of events in the target, then there must be a `<LinkType>TargetEvents` property in the source SmartObject.

The addLink procedure looks at the propertyType of the `<LinkType>Target` and `<LinkType>Source` properties (which returns the data-type of the property) to determine whether the link supports a single object or multiple objects. Typically a SmartLink supports only a single source, but can support more than one target. For example, a container can contain many other SmartObjects, which are its Container-Targets, but each of those objects has a single Container-Source. Likewise, a SmartObject, such as a SmartDataObject or SmartDataViewer, can have only a single Data-Source, but an SDO can have multiple Data-Targets. Additional user-defined SmartLinks for new SmartObjects can be defined to support single or multiple sources and single or multiple targets. This is done in the definition of the properties where the handles are stored.
If the data type of the property is HANDLE (which is typically the case for the <linkType>Source property), then this tells addLink that only a single object is permitted on that end of the link, and it runs the set<linkType>Source function to assign the property value to the source procedure handle.

If the data type of the property is CHARACTER (which is typically the case for the <linkType>Target property), then this tells addLink that multiple objects are permitted on that end of the link, and it runs the modifyListProperty procedure to add the target procedure handle to the list of handles of objects that are targets of that link (or the source if the source supports multiple SmartObjects). See the “Special functions that manage properties” section on page 5–41 for a description of propertyType and modifyListProperty.

The addLink procedure then looks at the <linkType>SourceEvents property in the target SmartObject, and subscribes the target procedure to each of those events in the source procedure handle. This causes the event procedure of the same name as the event to be run in the target each time the source publishes that event. In some cases the source of a link also receives messages from the target. In this case, there is also a <linkType>TargetEvents property in the source SmartObject, and addLink subscribes the source to those events in the target.

The lists of the events to which source events and target events of each standard supported link are subscribed are in a series of tables in the SmartLinks chapter of the ADM2 documentation.

To look at a specific example, examine the Container link. This link is not on the list of SupportedLinks for any SmartObject because every SmartObject can be a Container-Target, and every SmartContainer™ can be a Container-Source, so this link is created automatically when a SmartContainer is run and its contents are started (the addLink call to establish the Container link is in constructObject).

Because every SmartObject can be a Container-Target, the properties that define the source handle and events are in the property include file that all SmartObjectss share, smrtprop.i. They are, of course, also defined in the Repository. The ContainerSource property is defined as data type HANDLE, to indicate that there can be only a single Container-Source for a SmartObject. The ContainerSourceEvents property lists the events to which each SmartObject is subscribed in its parent container. This list includes initializeObject, hideObject, viewObject, destroyObject, enableObject, and confirmExit. When a container is initialized, for example, it publishes initializeObject, which causes each of its child SmartObjects to be initialized as they receive that event and run their own initializeObject procedure. The supporting functions getContainerTarget, setContainerTarget, getContainerTargetEvents, and setContainerTargetEvents are defined in smart.p, the super procedure used by all SmartObjects.

Only a container can be a Container-Source, so the properties describing the target are defined in the property include file for containers, cntnprop.i, and also in the Repository. There is a ContainerTarget property (of type CHARACTER), and a ContainerTargetEvents property, because each container subscribes to a single event in each of its child objects, exitObject. The super procedure for containers, container.p, contains the get and set functions for these properties.
Defining custom SmartLinks and events

In some cases, custom code added to SmartObjects must send an event from one SmartObject to another. If there is just one event type to send, you can define a dynamic SmartLink. To do this, add your own call to the addLink procedure at the appropriate place in your application code, and use the name of the event to be subscribed to, which must be the same as the internal procedure name to be executed when the event occurs. When addLink sees this reference to a link that is not in the SupportedLinks list for either the source or target object, it registers a single SUBSCRIBE statement for the target procedure for an event of the same name as the link and subscribes to the event in the source object. Because there is no predefined object property for the event and no get or set functions to manage the property value, a support procedure, called modifyUserLinks, stores the source and target handles in the ADM-DATA procedure attribute of the two objects so that the linkHandles function (described later) can return the object handles when they are requested. The exact format of the storage of these handles should not concern the developer. Always use the functions provided to get at these and other ADM values.

Link support methods

There are several additional methods that are used to modify and support links, including the methods described in the following sections.

removeLink, removeAllLinks, removeUserLinks

These functions delete one or more links from an object. The removeLink function removes a specific link between two objects, as shown:

Procedure removeLink:
  Parameters:  INPUT phSource AS HANDLE -- source procedure handle,
               INPUT pcLink   AS CHARACTER -- link type name,
               INPUT phTarget AS HANDLE -- link target object handle
  Candidate for: calling
  If your code needs to remove a specific link between two objects, it should use this call.

Your code does not normally run removeAllLinks, which deletes all standard (supported) links from an object. This includes deleting link definitions in the objects at the other end of the links, which is done automatically when the object is destroyed.

The procedure removeUserLinks removes user-defined links, which are not on the SupportedLinks list.
assignLinkProperty

This LOGICAL property sets a property value in an object at the other end of a specified link, relative to the current object (TARGET-PROCEDURE), as shown:

```plaintext
Function assignLinkProperty()
Parameters:  INPUT pcLink AS CHARACTER -- Link Type,
            INPUT pcPropName AS CHARACTER -- Property Name,
            INPUT pcPropValue AS CHARACTER -- Property Value.
Returns: LOGICAL (success flag)
Candidate for: calling
You can use this function when you know the name of the link that connects the current object to another, but not the handle of the object at the other end of the link. This allows you to set the property based on the relationship between the objects without having to retrieve the handles. If there's more than one object at the other end of the link, the property is set in all of them.
```

linkHandles

This CHARACTER function takes a link name and returns a list of handles of objects at the other end of that link, relative to the current object (the TARGET-PROCEDURE), as shown:

```plaintext
Function linkHandles()
Params: pcLink AS CHARACTER -- Link name (including "-SOURCE" or "-TARGET")
Candidate for: calling
Your code can use this function to retrieve a list of the procedure handles of the object or objects connected to the current object (the one the function is invoked in) by the link you specify. This could be useful if you need to do something beyond just setting a property value (for which you could use assignLinkProperty).
```

linkProperty

This CHARACTER function returns the value of the requested property in the object at the other end of the specified link, relative to the TARGET-PROCEDURE. Parallel to the assignLinkProperty function, this one retrieves the value of a property using the link name rather than the object’s handle.

If there is more than one object at the other end of the link (or none), the function returns blank, as shown:

```plaintext
Function linkProperty()
Params:  INPUT pcLink AS CHARACTER -- Link name,
         INPUT pcPropName AS CHARACTER -- Property name.
Candidate for: calling
You can invoke this function in your code to retrieve a property value when you know the link that associates two objects but not the handle of the object at the other end of the link.
```
**Miscellaneous link properties**

This section describes some useful link properties.

**SupportedLinks**

This CHARACTER property holds the list of all links routinely created for an object. It is a comma-separated list of link names, including the ~Source or ~Target suffix. As described earlier, you need a `<link>Source` or `<link>Target` property to hold the handles of the objects that use the link, along with a `<link>SourceEvents` or `<link>TargetEvents` property to hold the list of the events that the object should subscribe to in the related object.

This property is initialized in the property include files for the various SmartObjects. Because of the dependencies on other property names, you should not modify it. The user link mechanism allows you to create additional links dynamically when you need them.

**<link>Source and <link>Target**

For each link in an object’s `SupportedLinks` list that is a `<link>–Source`, there must be a `<link>–Target` property for the object. This holds the handle of the target for the link at run time. If the object can have multiple targets for the link, then the data type of the property must be CHARACTER, to hold the list of object handles. If the object can have only one target for the link, then the data type of the property should be HANDLE, to hold that one procedure handle in native form. Likewise, for each link in an object’s `SupportedLinks` list that is a `<link>–Target`, there must be a `<link>–Source` property for the object, which holds the handle of the source at run time. The same data type rules apply.

**<link>SourceEvents and <link>TargetEvents**

As described earlier in this section, these properties store the list of events that the object should be subscribed to in the handle of the object at the other end of the link. The `constructObject` procedure uses these properties together to accomplish all of the linking of objects, using the ABL `PUBLISH` and `SUBSCRIBE` statements.

**InactiveLinks**

This CHARACTER property contains a list of all links and handles for an object that are currently inactive.
Customizing and managing queries

OpenEdge Development: Progress Dynamics Basic Development has a chapter on business
logic that reviews how SmartDataObjects function and how to use the built-in entry points for
various kinds of basic validation logic. Other chapters discuss more advanced forms of business
logic. This section reviews the following useful functions and properties that you can use to
customize the WHERE clause and other aspects of the queries in your application:

- Modifying the WHERE clause at run time.
- Using addQueryWhere and assignQuerySelection .
- Refreshing the database query.
- Additional query methods.
- Other query properties.

Modifying the WHERE clause at run time

You can modify the base database query WHERE clause in many ways at run time. When you link
multiple SmartDataObjects together in a parent-child relationship, this modification is done
dynamically.

Using ForeignFields to filter a dependent query

If you want to browse through Customer records and then through Orders of a selected
Customer, you can do this by creating separate SDOs, one for Customer records and one for
Orders, and then linking them together. When you do this, the Order SDO uses a property
called ForeignFields to modify the WHERE clause dynamically, so that the Order SDO that was
originally defined with the simple query FOR EACH Order is now refined to select EACH Order
WHERE Order.CustNum = <CustNum>. The value of the <CustNum> field is retrieved from the
parent Customer SDO each time a new Customer is selected and plugged into the Order query
before that query is reopened. You can define the appropriate ForeignFields value either in the
AppBuilder for static window procedures or in the Container Builder for dynamic windows.

For the Customer/Order example, the initialization code for the Order SDO assigns the value
Order.CustNum, CustNum to the ForeignFields property. Each time a new Customer is selected
at run time, the dataAvailable event is published, and that event procedure in the Order SDO
queries the Customer SDO for the current value of the foreign field CustNum. Note that this field
refers to a field in the Customer RowObject table, and therefore is not qualified by a table name
(it could, in fact, be renamed from the actual database field it is derived from). This field’s value
is used to set the property ForeignValues, which holds the current values of a
SmartDataObject’s ForeignFields. The WHERE clause of the Order SDO is then modified for
you to insert the phrase Order.CustNum = <CustNum>, where <CustNum> is filled in from the
ForeignValues property, and the query is prepared and opened. A dependent query can contain
multiple foreign fields, and the values for them are kept in sync with the list of fields that make
up the foreign key.
The functions setQueryWhere and setQuerySort

The earliest versions of the Version 9 SmartObjects supported two basic functions to manipulate the WHERE clause: setQueryWhere and setQuerySort. These work well in straightforward cases, but setQueryWhere, in particular, does not deal well with successive changes to the WHERE clause or other more complex needs. Therefore, we do not recommend that you use setQueryWhere in new application code. The setQuerySort function can be used to change the sort sequence of a query, but remember that any query that has a WHERE clause or other filter applied to it is sorted automatically based on the indexes used to satisfy the query, and this is typically the most appropriate sort sequence.

If you want to allow users to sort a result set in different ways after it has been retrieved, you can do this more efficiently by manipulating the temp-table query instead of sorting and reopening the database query, as we discuss later in this section.

Instead, you should generally use the addQueryWhere and assignQuerySelection functions described below. These are much more flexible and can operate more efficiently.

The resortQuery function

The resortQuery() function takes an existing query and resorts it according to criteria you specify. For example:

```
DYNAMIC-FUNCTION('resortQuery':U IN h_dorder, INPUT 'BY ordernum DESCEND').
```

The setBaseQuery function

There is an additional function that can be of use in some cases, if you want to set a basic filter on a dataset so that it cannot be lost by changes to the WHERE clause later on. The property that stores the base query is BaseQuery, whose initial value is the query defined when the SDO is created. To apply a filter at run time that is not removed by other changes, you can reset this property, effectively overriding the basic definition of the SDO’s query in that instance. In the following example, we have run setOpenQuery to change the basic query to return only Customer records where the State field equals MA. All calls to the other WHERE clause functions then append their WHERE clause to this new basic query definition. Note that because we’re resetting the entire Open Query statement, we need to specify the query starting with FOR EACH.

```
Note: SDOs do not support the use of this function to change the database tables the query operates on.
```

You can override another default behavior of the SDO, which is to open its database query as soon as the SDO is initialized. You might not want to wait for that to happen if the SDO is always filtered before the data is actually used. In this case, you can reset the OpenOnInit property of the SDO mentioned earlier in this chapter to FALSE to cause it to wait until the openQuery function is run after initialization.
Using addQueryWhere and assignQuerySelection

Use the addQueryWhere function and the assignQuerySelection function to build more complex and efficient queries.

addQueryWhere

The addQueryWhere function takes three INPUT parameters:

- The new WHERE clause to be added to the existing one.
- An optional buffer name specifying which buffer in a join to add the WHERE clause.
- An optional operator to connect multiple WHERE clause fragments passed in successive calls. The default is AND, but you can also specify OR.

If you do not specify the buffer name parameter, then you must qualify the field names in your WHERE clause with their table names in order to allow the function to build the WHERE clause most efficiently, with each phrase appended to the query join clause where that table appears in the join sequence. The SDO property QueryString stores successive changes to the WHERE clause. This property is stored in the client SDO (if the SDO is split between client and server). When openQuery is run, it checks to see if the QueryString property has a value, and if so, sends it to the server, prepares the database query using that value, and then opens the query. This allows your code to build up a complex WHERE clause efficiently, without preparing or opening the intermediate steps (or even sending them to the server) until the signal is given to open the database query.

For example, if you create a new SmartWindow called waddwhere.w, you can use the addQueryWhere function to allow filtering of a query. To show how the function operates on a joined query, use a SmartDataObject called djoin.w, which joins "EACH Order, Customer OF Order, SalesRep OF Order". There is a field called Where-Field in the window that you can use to enter a new WHERE clause phrase, with this trigger code:

```java
/* ON LEAVE OF Where-Field */
DO:
  IF Where-Field:SCREEN-VALUE NE '' then
    DO:
      DYNAMIC-FUNCTION('addQueryWhere' IN h_djoin,
                        Where-Field:SCREEN-VALUE, '', '').
      Editor-1:SCREEN-VALUE IN FRAME {&FRAME-NAME}
        = DYNAMIC-FUNCTION('getQueryString' IN h_djoin).
    END.
  END.
END.
```

assignQuerySelection and removeQuerySelection

The assignQuerySelection and removeQuerySelection functions are designed to make it easy to map values to fields to create a WHERE clause. These functions are especially suited to application procedures, such as a Query By Form, where you enter a value for one or more fields and expect to see database records matching those values.
The first of these functions, assignQuerySelection, takes three INPUT parameters:

- A comma-separated list of fieldnames to be used in the WHERE clause.
- A CHR(1)-delimited list of values for those fields.
- An operator or list of operators to apply to the values. If this third parameter is not specified, EQUALS is the default. If a single operator is supplied for that parameter, it is applied to all field-value pairs. The special value of EQ/BEGINS means that numeric fields should use the EQ operator, and CHARACTER fields the BEGINS operator. Or a comma-separated list of operators can be supplied, and each operator in the list is applied to the corresponding field-value pair.

For example, you can use a SmartWindow called wselection.w to apply these functions to a Customer SDO. You can enter a list of fields in the Column-Field, and you can enter a list of values in the Values-Field. To simplify the example enter the values as a comma-separated list and replace the commas with CHR(1) when you use the list. Enter an operator in the third field. The leave trigger puts the pieces together and opens the SDO query with the values specified, as shown:

```plaintext
/* ON LEAVE OF Operator-Field */
DO:
   DYNAMIC-FUNCTION('assignQuerySelection' IN h_dcust,
                   Column-Field:SCREEN-VALUE,
                   REPLACE(Values-Field:SCREEN-VALUE,",",CHR(1)),
                   Operator-Field:SCREEN-VALUE).
   EDITOR-2:SCREEN-VALUE =
      DYNAMIC-FUNCTION('getQueryString' IN h_dcust).
      DYNAMIC-FUNCTION('openQuery' IN h_dcust).
END.
```

There is also a Remove-Field, which allows you to name a field that contains a WHERE clause fragment that you want to remove. Remove-Field executes the removeQuerySelection function, which takes two INPUT parameters: the name of the field and the operator associated with that field, as shown:

```plaintext
/* ON CHOOSE OF Remove-Field */
DO:
   DYNAMIC-FUNCTION('removeQuerySelection' IN h_dcust,
                   Remove-Field:SCREEN-VALUE,
                   Operator-Field:SCREEN-VALUE).
   EDITOR-2:SCREEN-VALUE =
      DYNAMIC-FUNCTION('getQueryString' IN h_dcust).
      DYNAMIC-FUNCTION('openQuery' IN h_dcust).
END.
```
You can test how these functions work by entering two field names, the values for those fields, and an operator.

To test this window:

1. Enter name,address for the Columns field.
2. Enter L,2 for the Values field.
3. Enter BEGINS for the Operator field.

The browse now displays all the customers that match those values:

Note that one feature of the assignQuerySelection function is that it handles quotation marks properly. The values entered into the list must not be in quotation marks. It is easier to assemble a list of values that come out of a list of fill-in fields for different database fields without having to add code to put quotes around those that need it (CHARACTER and DATE types); assignQuerySelection does this for you. Note that assignQuerySelection also identifies the table that each field comes from and qualifies the field name references. If there is a join involved, it also distributes the where clause phrases properly for maximum efficiency.
Typing **Address** into the **Remove** field runs `removeQuerySelection`, which removes that part of the **WHERE** clause from the query. For example:

![Test Window for Query Selection](image)

### Refreshing the database query

One of the most important things to keep in mind when using SDOs is that they always operate on a temp-table that is a snapshot of the database at the time the temp-table was built. This represents a compromise of some of the immediacy that older OpenEdge applications could take advantage of. In an older host-based or client/server application, you always knew that the database record you were looking at was one you were actually positioned to, and that you could lock a record while you worked on it. The realities of distributed applications require us to design record processing in which the client is not so tightly coupled to the database.

If you want to be able to run your application in a distributed environment, with databases on numerous machines in different locations, your client objects cannot sit on the **actual** database record, which is in a database they are not even connected to.

Therefore, you sometimes need to refresh the **RowObject** query your client objects are looking at. For example, a part of the application might be using a row when another part of your application signals that a row has been modified. One way to do this is simply to invoke the **openQuery** function. This reopens the database query and reloads the **RowObject** temp-table. If you wish, you can save off the **RowIdent** of the row your client is currently positioned to and reposition to that record after the query is reopened, using code similar to that in our mark and return example above.
If you simply want to refresh the row your client is currently looking at, you can refer to the third example in the sample reposition window. The **Modify Row** and **Refresh Row** buttons modify and then refresh a database record. The code under the **Modify Row** button simulates the situation of having a database record changed by another user while you are looking at it. It retrieves the current **Customer** record and changes the name, as shown:

```/* ON CHOOSE OF Modify-Btn */
DO:
    FIND customer WHERE customer.custNum = INT(Cust-Field:SCREEN-VALUE)
    NO-ERROR.
    IF AVAILABLE(Customer) THEN
        Customer.NAME = Customer.NAME + " MOD!".
    END.
END.
```

**Note:** Keep in mind that this is just a test procedure. In a real application window you would not do a database retrieval like this directly.

You do not see this change because it does not immediately affect your RowObject dataset. If you want to confirm that you are looking at the latest values for a record, you can click **Refresh Row**. This runs the `refreshRow` procedure, which re-reads the current RowObject row out of the database and writes its current field values into the RowObject table, as shown:

```/* ON CHOOSE OF Refresh-Btn */
DO:
    RUN refreshRow IN h_dcust.
END.
```

It also publishes the **dataAvailable** event, so that your viewer requests those fresh values and redisplay them. Click **dataAvailable** to see the "MOD!" to the Customer record:
Additional query methods

Use either the modifyNewRecord method or the collectChanges method to make changes to records.

modifyNewRecord

The standard entry points for writing data validation are described in the business logic chapters in *OpenEdge Development: Progress Dynamics Basic Development*. However, there is an additional new entry point available to developers so that you can make changes to a newly created record before it is first displayed, normally to assign initial values. This is the modifyNewRecord method. There is no standard code for this procedure, but it is run NO-ERROR during record creation in the SDO. Therefore, any code you write for it in your SDO data logic procedure is executed at the proper time. It takes no parameters, but you can refer to the temp-table record buffer in the same way that you do for validation procedures, using b_. plus the name of the primary table for the SDO.

Keep in mind that because modifyNewRecord is executed only in the client-side SDO, it will not be effective for initializing a record using a WebSpeed front-end to the application.

Here is a simple example for our Customer SDO, which initializes several of the fields assuming that the Customer is from New Hampshire:

```plaintext
Procedure modifyNewRecord:
/*-------------------------------------------------------------------------
 Purpose: Custom code for new records to initialize some of the fields in the Customer table.
 Parameters: <none>
 Notes: This is called automatically on Add or Copy.
----------------------------------------------------------------------*/
ASSIGN b_customer.State = 'NH'
   b_customer.phone = '(603)'
   b_customer.fax = '(603)'
   b_customer.postalcode = '030xx'
   b_customer.comments = "Here's another New Hampshire Customer!".
END PROCEDURE.
```
When you run the **Customer Maintenance** application window and click **Add**, you see the initial values shown in **Figure 5–4**.

![Customer Maintenance window](image)

**Figure 5–4:** Customer Maintenance window

**collectChanges**

The **collectChanges** named event is published automatically when a **Save** occurs. The event cascades down through any visual objects that contribute changes to the current record, such as multiple viewers with updateable fields from a single SDO.

It takes two **INPUT-OUTPUT** parameters that give each of these objects (viewers on different pages of a folder, for example) the opportunity to add their own changes and information about the changes to the growing list, passing it from procedure to procedure, as shown:

```
Procedure collectChanges:
    Params: INPUT-OUTPUT PARAMETER pcChanges AS CHARACTER
            INPUT-OUTPUT PARAMETER pcInfo    AS CHARACTER.
Candidate for: override
    You can create a local version of this procedure if your code needs to intercept the collecting of modified fields from the different objects in the window that have them, for example to adjust the changed values, contribute additional ones, or trigger some other related event.
```
Other query properties

Other useful query properties include:

- **DataHandle** — This property returns the handle to an SDO’s temp-table query. You can use this property to modify a query and reopen it.

- **RowObject and RowObjUpd** — These HANDLE properties hold the buffer handles of the RowObject and RowObjUpd buffers, respectively.

- **RowObjectTable and RowObjUpdTable** — These HANDLE properties hold the handles of the RowObject and RowObjUpd temp-tables.

- **AutoCommit** — This LOGICAL property is set automatically, depending on whether there is a Commit button or other object in a window that acts as a Commit-Source for an SDO. If there is, then the property is set to FALSE. If there is no Commit-Source, then it is set to TRUE. When it is TRUE, any Save to an SDO record is sent immediately to the server for validation and update. When it is FALSE, then saves are stored only locally in the client temp-table until the Commit event occurs. At that time all updates are sent back to the server together.

  **Note:** Autocommit triggered by one SDO’s update always applies to all unsaved changes in an SBO.

Paging methods and properties

There are several paging methods and paging properties that help manage objects and pages.

Paging methods

This section contains information about paging methods.

**assignPageProperty**

Use the assignPageProperty procedure to assign a property value to all the objects on the current page. If you must set a property on a page that is not the current page, you can reset the CurrentPage property to the page you want, run the procedure, and then set it back, as shown:

```
Procedure assignPageProperty:
  Params: INPUT PARAMETER pcProp AS CHARACTER
           INPUT PARAMETER pcValue AS CHARACTER.
  Candidate for calling
```
deletePage

Use the deletePage procedure to delete all the objects on the specified page, as shown:

```
Procedure deletePage:
  Params: INPUT PARAMETER piPageNum AS INTEGER.
  Candidate for: calling
```

hidePage

Use the hidePage procedure to hide all the objects on a page. Normally your code does not call this procedure directly, since the selectPage procedure automatically hides whatever was on the previous page, as shown:

```
Procedure hidePage:
  Params: INPUT PARAMETER piPageNum AS INTEGER.
```

initPages

Use the initPages procedure to initialize pages simultaneously. Normally pages are initialized when they are first viewed. The first page to be viewed is stored in the StartPage property, and all the objects on the page are started, initialized, and viewed when the window is run. Sometimes, however, you must initialize other pages at the same time in order to be able to create links to and from them, or to have objects prepared to receive data from objects on other pages. In this case, you can call initPages and pass it a list of the pages to be initialized on startup of the window, as shown:

```
Procedure initPages:
  Params: INPUT PARAMETER pcPageList AS CHARACTER.
  Candidate for: calling
```

viewPage

Use the viewPage procedure when you want another page to be displayed without hiding the objects on the current page. Normally this would be when the new page is in fact a different window, which you want to have appear in addition to the window containing the folder. Otherwise, when you want to hide one page and see another, run selectPage, as shown:

```
Procedure viewPage:
  Params: INPUT PARAMETER piPageNum AS INTEGER.
  Candidate for: calling
```
Using ADM2 Properties and Methods

selectPage

Use the selectPage support procedure when you want to switch the folder display from one page to another. It hides the objects on the current page, resets the current page to the INPUT parameter, and views the objects on that new page, as shown:

```plaintext
Procedure selectPage:
    Params: INPUT PARAMETER piPageNum AS INTEGER.
    Candidate for: calling
```

targetPage

Use the targetPage INTEGER support function to return the page that a specified object is on. Pass in the procedure handle of the object, as shown:

```plaintext
Function targetPage()
    Params:  phObject AS HANDLE.
    Returns:  INTEGER
```

Paging properties

This section contains information about page number properties.

ObjectPage

The ObjectPage INTEGER property is defined for all SmartObjects. It holds the page number that the current instance of the object is on.

CurrentPage

The CurrentPage INTEGER property is defined for containers. It holds the number of the currently selected page.

StartPage

The StartPage INTEGER property holds the page of the folder (beyond page 0, the background page) that should be initialized and selected on startup of the window.

InitialPageList

The InitialPageList CHARACTER property holds the list of page numbers that should be initialized on startup of the window as a comma-separated character string.

RenderingProcedure

This procedure specifies the name of the procedure that will be used to render an object. The value of this attribute will match that of the object name in the Repository and will be resolved into a filename with a path capable of being run.
Special functions that manage properties

There are some special functions that let you define new properties at run time and also return useful information about standard object properties. This section describes the following functions.

**instancePropertyList**

This CHARACTER function returns a list of the names of the object’s `instanceProperties`, which are properties that can be set to initial values in design mode. You can set these properties in the AppBuilder or in the Container Builder to determine the object instance’s behavior at run time. The list of standard instance properties is part of the definition of the object and stored in its `InstanceProperties` property, described just below. If you pass in a blank (""") for the INPUT parameter, you get back all instance properties and their values. Otherwise, you can pass in a comma-separated list of property names and get the values for just those properties back. If you want values for every property defined for the object, you can pass in an asterisk ("*"") as the INPUT parameter.

The RETURN value is a delimited list of property name/value pairs with CHR(3) between pairs and CHR(4) between name and value, as shown:

```
Function instancePropertyList:
  Params: INPUT pcPropList AS CHARACTER.
  Returns: property values.
  Candidate for: calling
```

**propertyType**

The `propertyType` CHARACTER function returns the data type of a property, as shown:

```
Function propertyType:
  Params: INPUT pcPropName AS CHARACTER.
  Returns: CHARACTER datatype of the property.
```

**setUserProperty**

This LOGICAL function assigns a value to a dynamically defined property and allocates a slot for the property if it does not yet exist. You can use `setUserProperty` to create properties for SmartObjects on the fly, without having to define functions to support them or predefine them in any way. It takes as INPUT parameters the name of the property and the value. Because these ad hoc properties and values are simply stored in a delimited string within the SmartObject, the values are always represented in CHARACTER form, as shown:

```
Function setUserProperty:
  Params: INPUT pcPropName AS CHARACTER,
          INPUT pcPropValue AS CHARACTER.
  Returns: LOGICAL (always true)
  Candidate for: calling
```
**getUserProperty**

This *LOGICAL* function retrieves the value of a dynamically defined property that you previously defined and set with the `setUserProperty` function. The values for these functions are always stored and returned in *CHARACTER* form, as shown:

```
Function getUserProperty:
  Params: INPUT pcPropName AS CHARACTER.
  Returns: CHARACTER property value.
  Candidate for: calling
```

**InstanceProperties**

This *CHARACTER* property returns the list of instance properties for the object. This list is normally hard-coded in the template for the object type as the `xcInstance-Properties` preprocessor, whose value is then assigned to `InstanceProperties` at startup of a static SmartObject. The value is also stored in the Repository for use with dynamic SmartObjects. In earlier product releases, this property was important for the AppBuilder to use when it generated code for use in its `adm-create-object` procedure. With dynamic windows, the distinction between instance properties and other properties is not as significant, and the value might not be meaningful for most applications.

**General-purpose methods**

The following additional methods are useful programming aids that do not fall into any other particular category.

**modifyListProperty**

This internal procedure allows you to add or delete values from any object property that is a comma-separated list. There are a number of such properties, such as `DisplayedFields` and `EnabledFields`, described in this chapter, and their values might need to be changed programmatically at run time. This procedure simplifies the job of adding or removing a string from within the list, as shown:

```
Procedure modifyListProperty:
  Params: INPUT phCaller AS HANDLE – handle of the object whose property is being changed
           INPUT pcMode AS CHARACTER -- 'ADD' or 'REMOVE'
           INPUT pcListName AS CHARACTER -- name of the property
           INPUT pcListvalue AS CHARACTER -- the value to add or remove
  Candidate for: calling
```
signature

This CHARACTER function returns the signature, or calling sequence, of the named function or internal procedure in the format returned by the ABL GET-SIGNATURE method. Because the entry point you need to access might in fact be implemented in a super procedure of the object where you actually run it, this function saves you from having to search through the super procedure stack to locate it, as shown:

**Function Signature:**
- **Params:** INPUT pcName AS CHARACTER -- function or procedure name.
- **Returns:** CHARACTER: signature in Progress GET-SIGNATURE format.
- **Candidate for:** calling
The Progress Dynamics framework is more than just a way of defining a user interface and logic to support a specific application. There is also a set of service procedures that support a wide range of application needs. These are called the Progress Dynamics Managers. You can learn more about the Managers in *OpenEdge Development: Progress Dynamics Administration*, *OpenEdge Getting Started: Installation and Configuration*, *OpenEdge Development: Progress Dynamics Getting Started*, and *OpenEdge Development: Progress Dynamics Managers API Reference*. This chapter begins with a brief overview of the managers and how they are constructed, and then provides some guidelines on how to use specific manager API calls in your applications.

Much of what the managers do is automatic and does not require any specific programming from you. Other parts of the managers are supported by specific administration tools, such as the Security Manager, where you interact only indirectly with the manager itself and its API.

This chapter focuses on the parts of each manager’s API that you can use explicitly in your application. It provides examples designed to give you a better understanding of how to use the managers to provide support for special needs that they do not take care of automatically, without attempting to provide a comprehensive description of each manager and all its procedures and functions.

This chapter contains the following sections:

- Overview of the managers
- Manager architecture
- Using the Session Manager
- Using the Configuration File Manager
- Using the Connection Manager
Using the Progress Dynamics Managers

- Using the Profile Manager
- Using the Localization Manager
- Using the Security Manager
- Using the General Manager
Overview of the managers

Just what is a manager, and what makes it special? The framework has many supporting procedures that contribute to your application’s behavior, but only a few of these are called managers. The Progress Dynamics managers have all of the following key elements in common:

- Managers have both a client-side and a server-side component, which communicate with each other when necessary. This allows all database access to be restricted to the server-side procedure when the application is run in a distributed environment, and to the client-side to provide data and services within its session, to minimize overhead and network traffic caused by AppServer calls.

- Managers are designed to use a stateless AppServer connection, so that a client request can be handled by an already running manager procedure in any server-side session, without binding that session to the client.

- Managers store needed context info in the Repository, so that a series of requests from a given client session can be handled coherently, even if by many different server sessions.

- Managers get data from different parts of the Progress Dynamics Repository, and they present that data to the application when it is needed. Generally, this means that among other things, data is cached in temp-tables on both sides of the AppServer connection, and kept in sync by the manager. In this way the client can access Repository data during the execution of the application without always going back to the server to get it.

- Managers have a standard design structure, which supports running efficiently between client and server. This structure is summarized below so that you can locate manager code you might need to look at or specialize. For additional information on manager design techniques, see Chapter 7, “Creating a New Manager.”

- Managers have an API of useful procedures and functions. Many of these procedures and functions are used internally by the manager itself or called from other managers, but some of them can also be called from application code. These calls are the focus of this chapter.

- Manager handles are available globally, making it easy to run any procedure in a manager.

- Managers are generally prestarted on the AppServer and on the client by the Session Manager. The configuration file section of the session management keeps information on all the managers, including which ones are needed by each Progress Dynamics session type. You can learn more about session types, registering managers, and how to associate managers with different sessions in *OpenEdge Development: Progress Dynamics Administration*, *OpenEdge Getting Started: Installation and Configuration*, and *OpenEdge Development: Progress Dynamics Getting Started*.

- Managers function independently of the ADM, SmartObjects, the Progress Dynamics User Interface, and other specifics of the framework. They can be used from a variety of existing application code, to provide security and session management, as well as from new Progress Dynamics-specific application modules. This can help to integrate new Progress Dynamics development work into existing applications.
Figure 6–1 provides an overview of the manager architecture.

The framework supports a Web browser-based user interface for an application. Part of this support involves generating a dynamic HTML-based UI for the browser by accessing the description of the UI through the Repository Manager. This is the same UI definition used to generate the Windows-based GUI. The Web support uses a User Interface Manager. In addition, a new Request Manager provides browser-based applications with access to the same manager functions available to ABL-based applications. The managers available in Progress Dynamics include:

- Session Manager
- Configuration File Manager
- Connection Manager
- Profile Manager
- Localization Manager
- Security Manager
- Repository Manager and Repository Design Manager
Overview of the managers

- General Manager
- Request Manager
- User Interface Manager
- Referential Integrity Manager
- Customization Manager

Session Manager

The Session Manager is responsible for starting and stopping Progress Dynamics processes. When you use the Dynamic Launcher in the AppBuilder to test a new dynamic window, it uses the `launchContainer` procedure in the Session Manager’s API to start the window. When you use the `launch.i` or `dynlaunch.i` include file to invoke business logic procedures on the server, the Session Manager starts those procedures, runs entry points inside them, and then stops them.

The Session Manager provides a host of other services as well. It handles the standard Progress Dynamics messaging calls described in the business logic chapters of OpenEdge Development: Progress Dynamics Basic Development. It provides the context management used by all the other managers to keep track of requests from each client session. It provides integration with the Progress Dynamics Help support. It provides an API through which you can access many system properties and define new properties of your own that your application needs.

Configuration File Manager

The Configuration File Manager keeps track of sessions, services, and other managers. All of its data is managed through the tools in the Session menu in the Progress Dynamics Administration window:
Use the Manager Type Control window to define new manager types and to identify which managers to prestart for which session types. The figure below shows all the managers that come with the framework. Each has a Type Code that you can use as an identifier to run procedures in its API and other information about the manager:

![Manager Type Control Window](image1)

Use the Session Type Maintenance window to define session types for the different ways in which your application or development environment needs to run. These built-in session types provide you with a variety of ways to start your client and server sessions, including a development environment with or without AppServer and a run-time GUI environment:

![Session Type Maintenance Window](image2)
The Service Type Control window lets you define system services that require special code to start and manage them. Progress Dynamics comes with built-in service types for AppServers, for databases, and for Java Message Service (JMS) partitions. Each Service Type defines a management procedure and a maintenance procedure that together provide the code to support the service, using a common API that is part of the Connection Manager:

You can define any number of specific services for each different service type. For example, for each database your application needs to connect, you can define the startup parameters and other connection information for each service. In the Logical Service Maintenance window you define a logical name or Service Code for each service, that is, for each different database connection and each AppServer connection:
In the **Physical Service Maintenance** window, you can define the specific startup parameters for the service, including database connection parameters, host, service, and network names:

![Physical Service Maintenance window](image1)

Each **Session Type** has properties that define characteristics of the session, such as whether it can run on the client only, its startup procedure, and the **Propath** for the session. You can maintain these in the **Session Property Control** window and then assign properties and values to different session types:

![Session Property Control window](image2)
You can define Profile types in the **Profile Control** window. Profile types are different categories of user profile information stored in the Repository. Use them to help personalize the interface and behavior of an application for each user:

The data you maintain with these different utilities is kept in the Repository, but much of it is also written out to an XML file, which allows each session to gain access to the configuration information it needs to start up. Here is a small excerpt from the standard Progress Dynamics XML representation of the configuration data, stored in `icfconfig.xml`:

```
<session SessionTypes="ASICFDev">
  <properties>
    <auto_dump_entity_cache>YES</auto_dump_entity_cache>
  </properties>
</session>
```

**Connection Manager**

The Connection Manager defines a standard API used by each of the service types, which are in turn defined in the Configuration File Manager. There is a common set of support procedures for the Connection Manager, and then a custom set of procedures for each different service type, such as Database and AppServer. The Connection Manager is responsible for connecting and disconnecting services, and interpreting their specific startup parameters.
Profile Manager

Progress Dynamics keeps track of a number of individual user preferences and settings in the Repository as part of a profile for each user. These include:

- The position and size of each window a user opens, so that a window comes up in the same place and is resized in the same way the next time the user opens it.

- Browser filter settings. Each time a user brings up a Progress Dynamics Filter window by selecting the Filter button on a toolbar, it provides the option of saving the filter settings, either for the session or permanently in the Repository, so that the browse comes up with the same filter applied the next time it is opened by the same user:

- A variety of specific session settings. These can be accessed from the Development or Administration windows by choosing File→Preferences. The Dynamic Preferences window appears:

The Profile Manager caches profile information on the client and returns changes to it to the server, normally at the end of the session.
Localization Manager

The Localization Manager supports translation of text in the user interface, including window titles, folder tabs, labels, ToolTips, messages, and menu items. It also supports a phrase translation glossary so that commonly used phrases can be translated once for each language. Those translations can be accessed and used wherever they appear.

You can bring up the basic translation mechanism by running any window that has the Translate menu option in its file menu, and selecting that option:

![Translate window](image)

Security Manager

The Security Manager controls access to:

- Menus and menu items.
- Objects such as folder tabs and buttons that have named security tokens.
- Data fields.
- Specific database tables and records.

All of these types of security are maintained in the Security menu of the Administration window. The Security Manager also keeps track of application user and password definitions. There is a chapter on how to define users and then apply security restrictions for those users in OpenEdge Development: Progress Dynamics Basic Development.

Repository Manager and Repository Design Manager

The data used by all of the managers is stored in the Progress Dynamics Repository, but the Repository Manager is specifically in charge of all the data that defines the user interface and all the objects that make up the application itself, including SDOs, data fields, browsers, viewers, windows, menus and toolbars, and folders. The Repository maintains a class definition for each object, with default attributes for the object. Each time you or the Object Generator creates an object, a record is stored for the master object, along with attribute value records for each attribute that does not have the default value.
Likewise, when you use an object in a container window, its attributes can be changed or defined at that level, so there is an instance record for each use of each object, which has its own attribute value records for values defined or overridden at the instance level.

The Repository Manager has a complex API used not only to set these values and define all the records needed to define an application, but also to retrieve all the data for an entire window in a single call. The API then caches data for objects that have already been displayed on the client so that they come up even faster when displayed again. Because of the very different needs for design time and run time, there are in fact two Repository Managers, one for a run-time environment, and the other, the Repository Design Manager, for the design-time environment. The first has an API optimized for returning object definitions to the procedures that realize them at run time, in the most efficient way possible. The Design Manager has an API designed for use with the AppBuilder, the Object Generator, and other tools that populate the Repository with data describing the objects in the application.

The object portion of the Repository and the Repository Manager APIs are described in more detail in Chapter 8, "Understanding the Repository Object Tables."

**General Manager**

As its name implies, the General Manager deals with a number of miscellaneous system support functions, including:

- Maintaining gapless sequences for database key values.
- Performing date and time conversions.
- Caching information on entities, that is, database tables and their fields, and how they should be used to generate default SDOs, browsers, and viewers for those tables.
- Tracking database record information, including whether comment or audit records exist for a database record.
- Listing manipulation functions that retrieve values from lists (property lists, for example) or insert them into lists.

**Request Manager**

The Request Manager supports requests that come in from a Web browser using the WebSpeed front-end to Progress Dynamics. The Request Manager plays two main roles in the processing of each request. The first is to evaluate the request and set up the environment in the correct and proper state for processing the actual request. The second role is the processing of the actual incoming Web request by executing the procedures and managers according to the request type. This manager mimics a large section of the GUI client behavior of the ABL Virtual Machine (AVM). As new non-AVM client types are added to the framework, the Request Manager will provide a standard channel through which all client requests are handled and communicated to the standard framework support code on the server.
User Interface Manager

The User Interface Manager (UIM) supports the generation of the user interface by a Web browser, and in principle, by any other non-AVM client types as well. It delivers all the information required for the client to draw the UI and control the run-time execution of an application developed using the Progress Dynamics framework. This includes the following:

- User interface (a screen, for example, **Order Entry**).
- Application data (for populating the user interface, for example, order number).
- User interface changes/behaviors (for example, enable/disable field, highlight/unhighlight fields and pop-up messages, information, menu, toolbar, TreeView, etc.).

The client is responsible for processing the output of the UIM and rendering the application UI. The manager is also responsible for retrieving client request data. It is expected that a new version (subclass) of the UIM will be created to support each different client type in future releases, each sharing a common API, and that the UIM will eventually be used for all client types.

Referential Integrity Manager

The Referential Integrity (RI) Manager provides support for the schema triggers that are part of the application deployment process. It supports code for data versioning and the reuse of object IDs when deployed objects are deleted and then re-created. It is also a placeholder for a more complete referential integrity definition in the Repository that will be implemented in a future release, when the relationship between tables and their keys will be expressed in Repository data, replacing the need for trigger procedures to do this. There is no public API for the RI Manager at this time.

Customization Manager

The Customization Manager’s primary function is to provide facilities for interpreting a customization reference, so that customizations of many kinds can be defined in the Repository and evaluated at run time in such a way that all the relevant customizations to the user interface and other application behavior are applied correctly for each individual user.

There is a section on customization and the Repository tables that support it in Chapter 8, “Understanding the Repository Object Tables.”
Manager architecture

The Progress Dynamics Managers have a common architecture that is worth studying in order to locate and understand code that you might need to modify or extend in some way. See Chapter 7, “Creating a New Manager,” for more information on building your own manager. This section describes the current manager architecture, including:

- Manager handles.
- Organization of the manager code.
- How the manager code runs on the server.

Manager handles

The principal Progress Dynamics managers, which are called most frequently from other framework code, have their procedure handles defined in an include file called globals.i, located in the src/adm2 director, as shown:

```plaintext
DEFINE NEW GLOBAL SHARED VARIABLE  gshAstraAppserver     AS HANDLE    NO-UNDO. /* Handle to Astra Application Server Partition */
DEFINE NEW GLOBAL SHARED VARIABLE  gshSessionManager     AS HANDLE    NO-UNDO. /* Handle Astra Session Manager */
DEFINE NEW GLOBAL SHARED VARIABLE  gshrIManager         AS HANDLE    NO-UNDO. /* Handle Astra Security Manager */
DEFINE NEW GLOBAL SHARED VARIABLE  gshSecurityManager    AS HANDLE    NO-UNDO. /* Handle Astra Security Manager */
DEFINE NEW GLOBAL SHARED VARIABLE  gshProfileManager     AS HANDLE    NO-UNDO. /* Handle Astra Security Manager */
DEFINE NEW GLOBAL SHARED VARIABLE  gshRepositoryManager  AS HANDLE    NO-UNDO. /* Handle Astra Repository Manager */
DEFINE NEW GLOBAL SHARED VARIABLE  gshTranslationManager AS HANDLE    NO-UNDO. /* Handle Astra Translation Manager */
DEFINE NEW GLOBAL SHARED VARIABLE  gshWebManager         AS HANDLE    NO-UNDO. /* Handle Astra Web Manager */
DEFINE NEW GLOBAL SHARED VARIABLE  gscSessionId          AS CHARACTER NO-UNDO. /* Unique session id */
```

Note: This file is in the src/adm2 directory not because it has anything specifically to do with the ADM2 code, which it does not, but simply to place it where many other include files used by SmartObjects are located. In older framework code, there are references to {af/sup2/afglobals.i}, which is equivalent. Note also that the include file contains several other application-specific handles not shown here because they are not relevant for general Progress Dynamics development.

These manager handles, along with the current Session ID and the handle of the default AppServer session, called AstraAppServer, are available from every Progress Dynamics procedure, because globals.i is included in all the standard Progress Dynamics template procedures, and also in src/adm2/smrtprop.i, which makes it part of the SmartObject procedures as well. While you should, in general, avoid global variables in applications, these basic handles are referenced so frequently that they are defined in this way for maximum efficiency. New manager handles should be defined and accessed as properties in the Session Manager, as we discuss in the chapter on building your own manager.
Organization of the manager code

The managers are written to allow a single body of code to be compiled for use on both the server and the client, with the portions requiring database access segregated to the server. For example, when using the Profile Manager, remember that a basic principle of the managers is that there is a server version of the manager that handles all Repository database access, and a client version that other procedures in the client communicate with. The code that is common to both client and server versions is placed in an include file whose name is of the form `afxxxmngrp.i`, where `xxx` represents a three-letter abbreviation of the manager name, such as:

- **con** — Connection Manager
- **gen** — General Manager
- **pro** — Profile Manager
- **sec** — Security Manager
- **ses** — Session Manager
- **trn** — Localization Manager

These include files are in the `af/app` directory. The `af` directory tree is where code related to supporting the framework itself is located (‘af’ stands for ‘application framework’). The `app` subdirectory is where code goes that runs on the AppServer in a distributed environment.

Two other procedures include this file:

- The client version of the manager is `af/sup2/afxxxc1ntp.p`. The `sup2` directory is where general support code for the application framework goes. The 2 in `sup2`, as in other framework directories such as `cod2`, indicates that this is code specific to the Version 9, or ADM2 version of the framework, as opposed to earlier code with its origins in Version 8.

- The server version of the manager is `af/app/afxxxmngrp.i`. Again, this is in the `af/app` directory because it is classified as AppServer Code. Each of these two procedures basically just defines a preprocessor and then includes `af/app/afxxxmngrp.i`. For example, this is the only code in `afproclntp.p`:

```plaintext
&global-define client-side yes
{af/app/afpromngrp.i}
```

This is the only code in `afprosrvrp.p`:

```plaintext
&global-define server-side yes
{af/app/afpromngrp.i}
```

These two preprocessors, client-side and server-side, allow the procedures in the common include file to separate out blocks of code where needed that should be compiled only on the server side of the manager or only on the client side, as we’ll see in a moment.
The code that must be separated out is largely code that accesses the Repository database. This code must be executed only on the server. Where the client needs access to the same data, it must run the same code on the AppServer.

The most efficient way to structure the manager on the server is to have all of the code, including the procedures that access the database, together in one persistent procedure where it can all be prestarted and therefore running whenever it is needed. On the other hand, when the client code must access the same database procedures, the most efficient way to do that is to make a single call to an external procedure (OpenEdge .r file) on the server, which takes INPUT parameters and returns whatever the result is as OUTPUT parameters. Making a single call like this to a stateless AppServer session does not bind the client to the server, and gets the results in a single AppServer call. By contrast, running an internal procedure inside a larger .r file requires making a call to establish the connection and run the .r file as a persistent procedure, then a separate call to run an internal procedure entry point inside it, and then another call to delete the server procedure. The client is bound to the AppServer session for the duration of this process.

To improve functionality, the managers use a technique of isolating database access code in external .p files to be run from the client, and then including those in a version of the same code that runs on the server.

The common include file, afpromgrp.i, has code in its main block that defines an internal procedure with the same name as each external procedure that contains server-side-only code. Only if the server-side preprocessor is defined, these definitions are compiled into the procedure that includes the common code, as shown:

```plaintext
&IF DEFINED(server-side) <> 0 &THEN
    PROCEDURE afbldclicp: {af/app/afbldclicp.p} END PROCEDURE.
    PROCEDURE afchkpdexp: {af/app/afchkpdexp.p} END PROCEDURE.
    PROCEDURE afgetpdatp: {af/app/afgetpdatp.p} END PROCEDURE.
    PROCEDURE afsetpdatp: {af/app/afsetpdatp.p} END PROCEDURE.
    PROCEDURE afupdcadbp: {af/app/afupdcadbp.p} END PROCEDURE.
    PROCEDURE afdelsprop: {af/app/afdelsprop.p} END PROCEDURE.
&ENDIF
```

In this way the version of the manager that runs on the server is a single large persistent procedure that incorporates all the database access code as well as the common code. This is an efficient way to operate because the managers are pre-started and left running for the duration of the AppServer session. Note that this version of the manager is also the one that runs if you are running locally, without an AppServer.
Each of the .p files is also compiled as a separate unit, so that its code can be run from a client session. Because each of these must be a simple procedure call, not a call to an internal procedure inside some larger file, all the executable code for these data access procedures must be in the main block, the part of the file that is executed when the procedure runs, as shown in Figure 6–2.

![Figure 6–2: Executable code in main block](image)

From a client session, the data access procedures are run as individual .r files on the AppServer, as shown in Figure 6–3.

![Figure 6–3: Data access file](image)

Within the server session itself, or when there is no separate AppServer, the data access code is compiled right into the manager itself.
For example, here is an excerpt of the code in the main block of the first support procedure for the Profile Manager, afbdclcp.p, which builds the temp-table cache of profile values for a user and returns it to the session where that user is running:

```c
/* ***************************  Main Block  *************************** */
DEFINE INPUT PARAMETER  pcProfileTypeCodes            AS CHARACTER  NO-UNDO.
DEFINE OUTPUT PARAMETER TABLE FOR ttProfileData.

... /* loop around profile codes for profile type */
FOR EACH gsc_profile_code NO-LOCK
    WHERE gsc_profile_code.profile_type_obj =
        gsc_profile_type.profile_type_obj:
    FOR EACH gsm_profile_data NO-LOCK
        WHERE gsm_profile_data.USER_obj = dUserObj
            AND gsm_profile_data.profile_type_obj =
                gsc_profile_code.profile_type_obj
            AND gsm_profile_data.profile_code_obj =
                gsc_profile_code.profile_code_obj:
        CREATE ttProfileData.
        BUFFER-COPY gsm_profile_data TO ttProfileData
        ASSIGN cProfileTypeCode = gsc_profile_type.profile_type_code
            cProfileCode = gsc_profile_code.profile_code
            cAction = "NON":U.
    END.  /* each profile data */

IF NOT (SESSION:REMOTE OR SESSION:CLIENT-TYPE = "WEBSPEED":U) THEN
    RUN buildClientCache(INPUT "":U). /* load temp-table on client */
```

Note that the procedure can take whatever input and output parameters it needs. This one takes a list of profile type codes as input and returns the resulting temp-table of all values of those types for the current user. This is then kept on the client to be used during the session. In some cases, you might find the parameters in the Definitions section of the procedure rather than in the main block. This is just an organizational choice and doesn’t affect how the procedure compiles.

Because this is code from one of the managers itself, it makes direct references to the Repository database tables. In code that you write in your application, including custom managers you create, you should use the available API for the manager, along with general-purpose routines, such as getEntityDescription, to get data from the Repository without direct reference to table and field names. The APIs are supported and kept compatible in the future; the specifics of the underlying table structure might be subject to change in future releases of the product.

Because this code is loading a temp-table of data for the client, it should not be run on the remote part of a distributed manager, but only in the client part of a distributed manager, or in a manager that is being run without AppServer. Thus, if you look at the main block of the common code include file, you see a reference that is found frequently in the manager code, as shown:

```c
IF NOT (SESSION:REMOTE OR SESSION:CLIENT-TYPE = "WEBSPEED":U) THEN
    RUN buildClientCache(INPUT "":U). /* load temp-table on client */
```
Looking next at `buildClientCache` itself, you can see an example of how the *internal* versus *external* partitioning is used in the code, as shown:

```
PROCEDURE buildClientCache:

DEFINE INPUT PARAMETER pcProfileTypeCodes AS CHARACTER NO-UNDO.

IF NOT (SESSION:REMOTE OR SESSION:CLIENT-TYPE = "WEBSPEED":U) THEN
  DO:
    EMPTY TEMP-TABLE ttProfileData.
    &IF DEFINED(server-side) <> 0 &THEN
      RUN afbldclicp (INPUT pcProfileTypeCodes,
                       OUTPUT TABLE ttProfileData).
    &ELSE
      RUN af/app/afbldclicp.p ON gshAstraAppserver (INPUT pcProfileTypeCodes,
                                                   OUTPUT TABLE ttProfileData).
    &ENDIF
  END.
END.
END PROCEDURE.
```

First it checks the `REMOTE` parameter as before. Then it starts by emptying the `Profile Data` temp-table in case there is any leftover data in it. This could be the case if the session is restarted.

Next comes the code block of interest. What it says, in effect, is if this is the server-side version of the manager, compile in a `RUN` statement to run the cache-loading procedure `afbldclicp` as an internal procedure within the manager. Otherwise compile in a statement to run it as an external procedure on the default AppServer handle.

This is not a coding style to follow in new code that you write, because new features in ABL allow you to achieve the same flexibility without this structure. But within the existing managers, it works effectively.

### How the manager code runs on the server

This example shows one way the managers run code without binding the AppServer session, by packaging that code as individually callable external procedures. There is another technique as well that you see in the manager code that also merits explaining.

Sometimes the code called from the client cannot effectively be packaged up into a separate .p file. In fact, a procedure on the client sometimes really must call itself on the server in order to return needed information. In other words, the client session must be able to run a procedure as if it were implemented locally. If the code for the procedure cannot be local, then the version of that procedure on the client must run a different version of itself on the server, where the code resides, that, among other things, accesses the database.

In this case, the server code is embedded inside an internal procedure that is part of the client-side manager. However, the server-specific code is compiled out of the client manager. So the entry point name exists on both sides of the server connection, but the code inside is different.
Let's look at an example from the General Manager, af/app/rygenmgrp.i, this time. The procedure `getEntityDescription` is a very useful general-purpose routine that can return the value of any field in the database, given the mnemonic or dump name of the table, the name of the field, and the unique object ID key value for the record within the table.

Because `getEntityDescription` can return the value of any field, there is no practical way for the client to cache all the data it might need to look at. For this reason, if code runs the procedure on the client, the client code turns around and runs the same procedure name on the server. So, first the procedure defines the parameters common to both client and server code, as shown:

```plaintext
PROCEDURE getEntityDescription:
DEFINE INPUT PARAMETER pcEntityMnemonic AS CHARACTER NO-UNDO.
DEFINE INPUT PARAMETER pdEntityObj AS DECIMAL NO-UNDO.
DEFINE INPUT PARAMETER pcFieldName AS CHARACTER NO-UNDO.
DEFINE OUTPUT PARAMETER pcEntityDescriptor AS CHARACTER NO-UNDO.
```

Then it uses the **server-side** preprocessor to compile in a call to the server if server-side is not defined. The include file `dynlaunch.i` that drives the call is the most efficient way to make a call to an internal procedure inside a server-side program, and return values from that procedure. Its named include file arguments include the name of the procedure or manager to run or access on the server; the name of the internal procedure to run; and a set of three arguments for each parameter to the internal procedure that specify the parameter's **INPUT**, **OUTPUT**, or **INPUT-OUTPUT** mode, the parameter name, and its data type. The `dynlaunch.i` include file turns this into a dynamic reference to the internal procedure that does all its work with a single AppServer hit, as shown:

```
&IF DEFINED(server-side) = 0 &THEN
{
  dynlaunch.i &PLIP = "'GeneralManager'"
  &iProc = "'getEntityDescription'"
  &compileStaticCall = NO
  &mode1 = INPUT &parm1 = pcEntityMnemonic
     &dataType1 = CHARACTER
  &mode2 = INPUT &parm2 = pdEntityObj
     &dataType2 = DECIMAL
  &mode3 = INPUT &parm3 = pcFieldName
     &dataType3 = CHARACTER
  &mode4 = OUTPUT &parm4 = pcEntityDescriptor
     &dataType4 = CHARACTER
}
IF ERROR-STATUS:ERROR OR RETURN-VALUE <> "":U THEN RETURN ERROR RETURN-VALUE.
```

This is different from the previous example, where the server code is run as a separate procedure when needed and then goes away. In this case, the procedure you want to run is inside the server-side General Manager that is already up and running, so you do not want to run a new copy of it. The `dynlaunch.i` file works whether the server-side program is already running as a persistent procedure or manager, or whether it must be started for the request and then terminated when it returns.
This is the end of the code that gets run if the procedure is compiled for the client. Following this is an `&ELSE` block that is compiled if the code is compiled for the server. This is the guts of `getEntityDescription`, the code that does all the work:

```sql
&ELSE

DEFINE VARIABLE cQueryPrepareString AS CHARACTER NO-UNDO.
DEFINE VARIABLE cTableObjectFieldName AS CHARACTER NO-UNDO.
DEFINE VARIABLE cTableBase AS CHARACTER NO-UNDO.
DEFINE VARIABLE hQuery AS HANDLE NO-UNDO.
DEFINE VARIABLE hBuffer AS HANDLE NO-UNDO.
DEFINE VARIABLE hDescriptionField AS HANDLE NO-UNDO.
DEFINE VARIABLE hCurrentField AS HANDLE NO-UNDO.
DEFINE VARIABLE iFieldLoop AS INTEGER NO-UNDO.

FIND ttEntityMnemonic WHERE
    ttEntityMnemonic.entity_mnemonic = pcEntityMnemonic
    NO-ERROR.

...etc.
```

In this way, code in a single file (the common code include file in this case) can be compiled two different ways to execute in a coordinated fashion between client and server.

### Using the Session Manager

The Progress Dynamics Session Manager handles a wide range of application functions. For a complete description of each manager, see *OpenEdge Development: Progress Dynamics Managers API Reference*. Major areas covered by the Session Manager include the support for context management, setting and getting properties, launching procedures, error and messaging management, help management, and e-mail and session logon support. This section includes:

- Context management.
- Property management.
- Managing procedures and containers.

### Context management

The Session Manager keeps track of information that must span the client/server divide, that is, information that must be available to business logic regardless of whether it is running client or server side. Business logic should not have to be concerned with where it is being run and should function exactly the same in any environment.
To facilitate this, the Repository database has a context database table, shown in Figure 6–4, called gsm_server_context. This table is a generic table used to store context information of any kind between stateless AppServer connections.

![Context database table](image)

**Figure 6–4:** Context database table definitions

As you can see from the table definition, all context records are identified by a session_obj, which joins to a session record in a separate gst_session table. This is based on the session:server-connection-id, which provides a unique code for the current client connection. The ID is maintained from the time of connection to the AppServer until a disconnect statement. The value is also available to the client via the client-connection-id attribute of the AppServer object handle if an AppServer is in use.

For code portability when not using AppServer, code always refers to the global shared variable gscSessionId, which you saw earlier in globals.i, rather than the session:server-connection-id. This is set during application start-up on the client. On the server it is set during session activation and reset on deactivation. The type of information that is stored by the framework itself in the context table includes user information, security information, etc.

The context table stores a date and time stamp for each value, indicating when it was last set and the name and value of the information itself. The context_name field is, therefore, just a property name.

Apart from a deleteContext call to destroy the context information for a user, the API that provides applications access to the context table is a function of property management.
Property management

The Session Manager on the client maintains a temp-table of property values representing context information needed by the client. For values stored in the temp-table, no server call is necessary to retrieve a value. This temp-table is initialized at session start-up with values for the standard client properties such as user ID and login company. These values are then passed to the server if they are also needed there. Only properties that are solely maintained on the client can be cached locally on the client in this way, even though their values can be read server-side. If it is possible for code to modify the property value on the server, then the client temp-table cannot have the property value, and the client must always redirect the request for the property to the server.

The Session Manager is also used for client-side properties that do not need to be reflected on the server. For these properties, the value is only managed on the client. This can be a useful and efficient mechanism for temporary storage of information between program calls, as the Session Manager is always initiated at the start of every session and runs in every client session.

If there is no AppServer connection, then the server version of the Session Manager is run on the client. In this case, all properties are cached in the temp-table and the context database table is not used.

In addition to the many standard properties already defined, application code can define and store any additional properties just by passing them to the Session Manager. There are two simple calls to do this:

- **getPropertyList** (INPUT pcPropertyList AS CHARACTER, INPUT plSessionOnly AS LOGICAL) -RETURNS CHARACTER — This function retrieves the specified property values from the local temp-table if they’re available. If they are not available in the temp-table, then the function makes a call to the AppServer to check the context database table. If the Session-Only flag is set to YES and the request is made on the client side, then the context database table is not checked. The input property list can also be a comma-separated list of property names. The return value is a CHR(3)-delimited list of values. It’s advisable to get (and set) as many values together as possible if they must be retrieved from the server, to minimize AppServer traffic, as shown:

  DYNAMIC-FUNCTION("getPropertyList":U IN gshSessionManager
  ( INPUT pcPropertyList,
    INPUT plSessionOnly )).

- **setPropertyList** (INPUT pcPropertyList AS CHARACTER, INPUT pcPropertyValues AS CHARACTER, INPUT plSessionOnly AS LOGICAL) -RETURNS LOGICAL — This function sets the specified property values in the local temp-table if it is run on the client side. If it is invoked on the client and the Session-Only flag is set to NO, then the property is also set in the context database table for use by the remote session, as shown:

  DYNAMIC-FUNCTION("setPropertyList":U IN gshSessionManager
  ( INPUT pcPropertyList,
    INPUT pcPropertyValues,
    INPUT plSessionOnly )).
Here are a few things to keep in mind when you use these functions:

- As noted, you can define a new property just by using it in a call to `setPropertyList`. For this reason, it is important to check for spelling errors in calls to the function, because an attempt to set a property using the wrong name silently creates a new property with the wrong name and sets its value instead.

- Always consider which property values are needed on the client and which are needed on the server. You can use the property functions and the context table to store any information that might be needed elsewhere in the application. If it is needed only by other client-side code, then always set the `Session-Only` flag to `YES`. In this way, the value is stored only in the client temp-table. If business logic on the server could use or set the value, then you must set the `Session-Only` flag to `NO` and consider that every time you set the property, or retrieve it from the client, you incur an AppServer hit.

- To set a property value to null, use an empty string (""'), not the Unknown value (?)

### Managing procedures and containers

The central purpose of the Session Manager is to control all the running objects in the system, including the other managers, application components, and supporting business logic procedures. Much of this work happens automatically, based on information defined in many places, such as:

- The configuration file and Connection Managers, which define which managers are started for each `Session Type`, what the startup options are, etc.

- Menus and toolbars, which launch other objects, both static and dynamic, on Choose of a button or menu item, as defined in the Toolbar and Menu Designer.

- Definitions of custom super procedures for objects in the object property sheets or the Repository Maintenance tool, which cause the Session Manager to start these supporting objects and make them super procedures.

- Application code that starts and makes requests of business logic procedures.

This section describes the procedures in the Session Manager’s API that you can use in your applications to control the running of other application objects, both static and dynamic.

### Using launchProcedure and launch.i

Call `launchProcedure` to start any persistent procedure your application needs, as shown:

```plaintext
RUN launchProcedure IN gshSessionManager
   ( INPUT pcPhysicalName,
   INPUT pOnceOnly,
   INPUT pcOnAppserver,
   INPUT pcAppserverPartition
   INPUT p1RunPermanent,
   OUTPUT phProcedureHandle  )
```
See *OpenEdge Development: Progress Dynamics Managers API Reference* for more information on this call. Your code should normally not run `launchProcedure` directly. Instead, the `launch.i` and `dynlaunch.i` include files act as a wrapper for calls to `launchProcedure`, allowing you to name both an external procedure to run and also the name of an entry point inside it, along with any INPUT and OUTPUT parameters to the internal procedure and other details that help encapsulate the calls. `dynlaunch.i` is the generally preferred include file to use if you do not require access to the server-side procedure after your request completes. It deals with the entire request in a single AppServer call.

**Using launchContainer**

You have already seen the `launchContainer` call in action many times. This is what the Dynamic Launcher uses to start a dynamic container that you must test. It is what the AppBuilder runs if you select the runner icon for an open container. It is also used from the toolbar and menu support code in `toolbar.p` to start containers that are run on Choose of a menu item or toolbar button.

You can use `launchContainer` within your own application code as well. One important use is to help you integrate existing menus or windows in an older application with new modules that you’re developing in Progress Dynamics. Buttons or menu items added to your current application can launch dynamic containers built in Progress Dynamics, so that both can become part of a single integrated application. This section shows an example of how to do this.

First look at the `launchContainer` call itself, as shown:

```plaintext
RUN launchContainer IN gshSessionManager
   ( INPUT pcObjectFileName,
     INPUT pcPhysicalName,
     INPUT pcLogicalName,
     INPUT plOnceOnly,
     INPUT pcInstanceAttributes,
     INPUT pcChildDataKey,
     INPUT pcRunAttribute,
     INPUT pcContainerMode,
     INPUT phParentWindow,
     INPUT phParentProcedure,
     INPUT phObjectProcedure,
     OUTPUT phProcedureHandle,
     OUTPUT pcProcedureType).
```

The `launchContainer` call takes the following parameters:

- **INPUT pcObjectFileName (CHARACTER)** — The object filename used when you do not know the physical and logical names. Use this parameter to launch a physical object (static procedure) rather than a dynamic object.

- **INPUT pcPhysicalName (CHARACTER)** — The physical object name (with path and extension) if known. The difference between this and the object filename can be confusing. This is not an individual static procedure to support a single window. Rather, it is the single driver procedure that instantiates all windows at run time. For standard dynamic windows, always set this parameter to the procedure `ry/uib/rydyncontw.w`, which is the standard framework procedure used to create any dynamic container window. For Progress Dynamics TreeView windows, specify the file `ry/uib/rydyncntreew.w`.
• **INPUT `pcLogicalName` (CHARACTER)** — The logical object name of the container. This is the name you give to the container window when you create it.

• **INPUT `p1OnceOnly` (LOGICAL)** — This logical flag indicates whether there might be more than one instance of this procedure running concurrently. If it is `FALSE`, then the Session Manager checks whether there is already a running instance of the object in memory, and if so, reuses that. There is a Progress Dynamics ADM2 container property called `MultiInstanceActivated` that is set to reflect the user preference for multiple windows. Users can set this in the `File → Preferences` window from the Progress Dynamics Development or Administration windows. This choice is overridden if the object does not support multiple instances as identified by the `MultiInstanceSupported` container property. If this is `FALSE`, then only one instance will ever be run, regardless of the `OnceOnly` value passed in. This is general for object controllers and filter windows.

• **INPUT `pcInstanceAttributes` (CHARACTER)** — The SmartObject instance attributes and values to pass to the container, if any. If an instance attribute list is passed in, the list must be in the same standard ADM2 format as returned to the function `instancePropertyList`, with `CHR(3)` between entries and `CHR(4)` between the property name and its value within each entry. These attributes are then set in the container prior to running `initializeobject` in the container. The Session Manager procedure `setAttributesInObject` is used to set the attributes.

• **INPUT `pcChildDataKey` (CHARACTER)** — The child data key, if applicable. When you invoke a maintenance window from an object controller browse window, for example, the browse window passes in the key value for the selected row the maintenance window should start on. This is the child data key. If a child data key is passed in and the `OnceOnly` flag is `NO` to enable multiple instances, then a check is made for an existing running instance with the same data key. If one is found, then regardless of the `OnceOnly` flag, this instance is just brought to the top, since it is invalid to have multiple instances of a container for the same data key. Also, if the object itself does not support multiple instances, the data key passed in is set to blank. `ChildDataKey` is a SmartObject property you can query in order to set this parameter correctly, when this is appropriate.

• **INPUT `pcRunAttribute` (CHARACTER)** — The run attribute if this is required to pass into the container. This could be specified in the Toolbar and Menu Designer, for example, for the action on a menu item. This run attribute is different from the SmartObject attributes and is not normally used.

• **INPUT `pcContainerMode` (CHARACTER)** — This is the initial operating mode for the container: view or update, for example. Pass this in as blank to get the default.

• **INPUT `phParentWindow` (HANDLE)** — The parent (caller) window handle, if known. This could be the handle of the window invoking the new container, if you want that to be its parent.

• **INPUT `phParentProcedure` (HANDLE)** — The parent (caller) procedure handle, if known.
Using the Session Manager

- **INPUT phObjectProcedure (HANDLE)** — The parent (caller) object handle, if known. The handle of the object linked to the toolbar that contained the menu can also be passed in, for example, the handle of a browser or viewer. If you use `launchContainer` to invoke new windows from old ones where there is no meaningful parent object, then this parameter can be passed in as the Unknown value (?).

- **OUTPUT phProcedureHandle (HANDLE)** — The procedure handle of the container being run is returned in this output parameter.

- **OUTPUT pcProcedureType (CHARACTER)** — The procedure type of the container being run is returned in this output parameter. This is normally the string ICF.

**Integrating old and new applications**

This section contains an example of how to use the `launchContainer` procedure and the Session Manager to combine existing application modules and new Progress Dynamics modules in a single application. Figure 6–5 shows a simple application window that represents any window or menu in your current application. This one is a static SmartWindow, but any procedure window or other application procedure will do.

![Figure 6–5: Sample application window](image)

In the example, you launch Progress Dynamics containers from this window, and then later launch the window itself from a Progress Dynamics menu.

**Creating a sample application window**

The procedure below shows one way to create an application window.

**To create the sample application window:**

1. Build a new static SmartWindow in the AppBuilder.

2. Drop two buttons on and label them Customers and Orders. You can use those or build any similar objects of your own to complete the example.

3. If you use the Progress Dynamics version of the AppBuilder to create a new static SmartWindow, it will refer to the include file `globals.i` already in the Definition section, as every Progress Dynamics procedure does. Otherwise, you must add it to your procedure. Also, define two variables at the scope of the procedure to hold the handles of the Customer and Order windows to launch, as shown:

```
{src/adm2/globals.i}
DEFINE VARIABLE ghCustomerWin AS HANDLE NO-UNDO.
DEFINE VARIABLE ghOrderWin   AS HANDLE NO-UNDO.
```
4. Create an internal procedure called launchDynWindow. This takes as an INPUT parameter the logical name of the window to launch, and returns its procedure handle as an OUTPUT parameter. The parameters passed to launchContainer should be clear from the previous explanation of the procedure. As noted, the first argument (ObjectFileName) is not used. Instead, the name of the dynamic container procedure is passed in, along with the logical name of your container. The ParentWindow argument is the handle of the window in the sample procedure, which in our case is wiWin. The ParentProcedure parameter is its procedure handle, as shown:

```plaintext
PROCEDURE launchDynWindow:
/*---------------------------------------------------------------------
 Purpose: Uses the launchContainer procedure in the Session Manager to run a dynamic window from this static window.
 Parameters: INPUT pcWindowName AS CHARACTER -- the logical window name,
 OUTPUT phProcedureHandle AS HANDLE -- the new window handle
 Notes:---------------------------------------------------------------------*/
DEFINE INPUT PARAMETER pcWindowName AS CHARACTER NO-UNDO.
DEFINE OUTPUT PARAMETER phProcedureHandle AS HANDLE NO-UNDO.
DEFINE VARIABLE cProcedureType AS CHARACTER NO-UNDO.
RUN launchContainer IN gshSessionManager
( INPUT /* pcObjectFileName */    "", 
  INPUT /* pcPhysicalFileName */  "ry/uib/rydyncontw.w", 
  INPUT /* pcLogicalName */        pcWindowName, 
  INPUT /* plOnceOnly */           YES, 
  INPUT /* pcInstanceAttributes */ "", 
  INPUT /* pcChildDataKey */       "", 
  INPUT /* pcRunAttribute */       "", 
  INPUT /* pcContainerMode */      "view", 
  INPUT /* phParentWindow */       wiWin, 
  INPUT /* phParentProcedure */    THIS-PROCEDURE, 
  INPUT /* phObjectProcedure */    ?, 
  OUTPUT   phProcedureHandle, 
  OUTPUT    cProcedureType /* ICF */    /* ICF */ ) .
END PROCEDURE.
```

5. Create two trigger blocks. The first is for the Choose trigger on the Customer button. Use as the INPUT parameter the name of one of the logical container objects from the tutorial application or any others that you have built, as shown:

```plaintext
DO:
  RUN launchDynWindow (INPUT 'custbrowsewin', 
                      OUTPUT ghCustomerWin).
END.
```

This second block of code is for the Choose trigger on the Order button, as shown:

```plaintext
DO:
  RUN launchDynWindow (INPUT 'orderbrowsewin', 
                      OUTPUT ghOrderWin).
END.
```
6. This is all you need to do to integrate your static window in with the dynamic containers. Run this code to see:

![Static Customer and Order Management Window](image)

7. Click Customers to launch the dynamic Customer browse window:

![Customer Selection Window](image)

8. Save your window as testlaunch.w. The Save dialog box appears:

![Save Dialog Box](image)

9. Select the Register object toggle.


11. Click Save to save your window and register it in the Repository. Now you can reference it within the Progress Dynamics development tools.

**Note:** There are two object attributes that you might need to set differently from the default settings you get when you add the object to the Repository. In order for the Toolbar and Menu Designer to know that this is a container object and that it can be run from a menu, the object must have the Container Object and Runnable From Menu attributes set. These attributes are available on the testlaunch node’s More tab in the Repository Maintenance tool.
Adding a static window to the Dynamic Menu Controller window

This example uses the tutorial oemenuwin menu and the testlaunch.w window that you just created.

To add the static window to a dynamic Menu Controller window:

1. Open the Toolbar and Menu Designer and select ds-General as the Module. This filters down the list of Items and Bands.
2. Select Toolbar & Menu Designer → Bands → Submenu Bands → oeSubMenuBand:

![Toolbar and Menu Designer interface](image)

3. Right-click and choose Add Item to Band from the pop-up menu.
4. Choose the Item (add to Band) tab.
5. Type OldWindow for the Item reference and add a Description.
6. Select LAUNCH as the Action type.
7. Type testlaunch for the Object filename.
8. Select DynSports as the Category.
9. Click **Save**. The new item appears under the **oeSubMenuBand** node:

![Image of Toolbar and Menu Designer]

10. Choose the **Band Item** tab.
11. Type **OldWindow** as the **Item reference** and press **TAB**.
12. Set the **Item sequence** to 3.
13. Click **Save** to complete adding the new menu option:
14. Exit the Toolbar and Menu Designer. Because the oemenuwin window uses the **Order Entry** band, the item you just added to it appears automatically when you run that menu window. Test your change by running oemenuwin from the Dynamic Launcher. Click the **Destroy ADM Super Procedures** toggle box on to clear the client cache of menu items. Your new item appears in the **OrderEntry** menu:

![OrderEntry](image)

15. Choose **OldWindow**, and the static SmartWindow appears:

![OldWindow](image)

So now you see how to make changes to both an existing static application, with or without SmartObjects, and to a Progress Dynamics application, to integrate old and new modules in a single session.

**Using launchExternalProcess**

In addition to launching dynamic objects and ABL windows using the Session Manager, you can also launch external windows processes using the **launchExternalProcess** call, as shown:

```plaintext
RUN launchExternalProcess IN gshSessionManager
   ( INPUT pcCommandLine,
     INPUT pcCurrentDirectory,
     INPUT piShowWindow,
     OUTPUT piResult   ).
```

The call takes these parameters:

- **INPUT pcCommandLine (CHARACTER)** — The command line to use. For example: `notepad.exe <filename>`.
- **INPUT pcCurrentDirectory (CHARACTER)** — The default directory for the process.
- **INPUT piShowWindow (INTEGER)** — The show window flag, which can have one of these values:
  - 0) — Hidden
  - 1) — Normal
  - 2) — Minimized
  - 3) — Maximized
- **OUTPUT piResult (INTEGER)** — The result of the attempted launch action which can be either 0, which indicates failure, or a non-zero value, which is the windows handle of new process.
The `launchExternalProcess` call uses the `CreateProcessA` API function in Windows NT or Windows 2000.

To see an example of how this works:

1. Add another button to your `testlaunch.w` window labeled **Notepad**.
2. Define this Choose trigger for it:

   ```
   DO:
   DEFINE VARIABLE lResult AS LOGICAL NO-UNDO.
   RUN launchExternalProcess IN gshSessionManager
   (INPUT "Notepad.exe " + THIS-PROCEDURE:FILE-NAME,
    INPUT ",",              /* default directory */
    INPUT 1,               /* window state -- normal */
    OUTPUT lResult).
   END.
   ```

3. Rerun your window:

4. Click **Notepad** to bring up the Windows Notepad program to edit the current procedure. In this case, because it’s being invoked from the AppBuilder, you see the temporary file the AppBuilder creates for the procedure you’re working on:
Using the Configuration File Manager

The Configuration File Manager is different in its construction from the other Progress Dynamics managers. Because it starts every other manager in the framework, it is the first procedure run by Progress Dynamics on startup. Its principal procedure file is af/app/afxmlcfgp.p, and it does not use the techniques described in the “Manager architecture” section on page 6–14. Because the Configuration File Manager is so fundamental to the framework, its handle is not stored as a global variable as with the other basic managers. Instead, it makes itself a super procedure of the ABL Virtual Machine (AVM) session it is run in, so that any procedure in an application can run one of its entry points as if it was in the application itself (IN THIS-PROCEDURE, in other words), and it can be found in the session super procedure.

The “Overview of the managers” section on page 6–3 summarizes the utilities that you normally use to define and maintain manager types, session types, session properties, and other data in the domain of the Configuration File Manager. More information on using those utilities is in OpenEdge Development: Progress Dynamics Administration. This section notes the API calls in this manager that you are most likely to want to use in your code.

Using the isICFRunning function

You can call the isICFRunning function in your code to determine if Progress Dynamics is running. This is especially useful if your application contains a mix of new and old code that must operate differently depending on whether Progress Dynamics is running. Remember that ICF is the generic name for the Progress Dynamics product.

For example, in the testlaunch.w file you built earlier in this chapter, you might want to leave out the buttons that run Progress Dynamics-dependent components if the framework itself is not running. You can do this by adding this code to your startup in the main block of testlaunch.w in this example:

```
DEFINE VARIABLE lDynamics AS LOGICAL NO-UNDO.
lDynamics = DYNAMIC-FUNCTION('isICFRunning') NO-ERROR.
IF lDynamics NE TRUE THEN
  ASSIGN buCustomer:HIDDEN = YES
  buOrders:HIDDEN = YES
  buNotepad:HIDDEN = YES.
```

Note that it is important to invoke the function NO-ERROR, since if the Configuration File Manager is not running, then the icICFRunning function is not defined, resulting in a run-time error. You also must make sure that you code does not have any other Progress Dynamics dependencies if it must work properly both with and without the framework.

Admittedly, this is a fairly silly example, since the test window only has buttons for Progress Dynamics-dependent functions, but if you run testlaunch.w from an AVM session that does not start Progress Dynamics, you can confirm that the buttons do not appear:
Using the Configuration File Manager

Using the getManagerHandle function

The handles of the basic managers are available as global variables defined in
src/adm2/globals.i. New managers and other useful handles should not be defined in this
way, to avoid the unnecessary proliferation of global variables and the need to recompile every
procedure in the framework, and also in your application, when one is added.

For all managers, the Configuration File Manager supports a function that returns the handle
based on the manager’s name, or more precisely, the Manager Type Code from the Manage
Type maintenance utility under the Session menu. If you look at all the existing managers, you
can see the Manager Type Codes for them, and also note the value of the Static Handle field.

The first thing to note is that the Configuration File Manager itself is not on the list. This is
because it’s always the first thing started and always starts everything else, so only other
managers are listed in the configuration information for a session.

Look at the Static Handle field in Figure 6–6 and note that all the basic managers, except for
the Connection Manager, have a two- or three-letter symbol for the handle name. This indicates
that there is a static handle for the manager. The Connection Manager has a Static Handle code
of NON, short for none, meaning no static handle available.

![Figure 6–6: Static Handle field of the Manager Type Control](image)
If you edit the Manager Type for one of the other managers, a Static Handle name such as gshSessionManager, is shown. Figure 6–7 shows that there is no static handle for the Connection Manager.

Figure 6–7: Manager Type Maintenance - ConnectionManager

This is because the Connection Manager was created after the other basic Progress Dynamics managers, and observes the policy of not creating new handles for new managers. To obtain its handle, use the getManagerHandle call, as shown:

```
hManager = DYNAMIC-FUNCTION('getManagerHandle', pcManagerTypeCode).
```

You can reference the API calls in the Configuration File Manager as if they were in your application procedure, but because no function prototypes for the functions are included, you must use the DYNAMIC-FUNCTION syntax to avoid a compile-time error message that the compiler does not recognize the function name.

Here is an example of using this call:

```
/* testManagerHandle.p -- test the getManagerHandle function. */

DEFINE VARIABLE hConn AS HANDLE     NO-UNDO.
DEFINE VARIABLE hSess AS HANDLE     NO-UNDO.
    hConn = DYNAMIC-FUNCTION('getManagerHandle', 'ConnectionManager').
    hSess = DYNAMIC-FUNCTION('getManagerHandle', 'SessionManager').
    MESSAGE "The Connection Manager is running " hConn:FILE-NAME SKIP
        "and the Session Manager is running" hSess:FILE-NAME.
```

Note that because you do not use the global handle variables in globals.i, you do not need to reference the include file unless your code elsewhere references one of the other manager handles directly.

Run this code to see the Message window:
Checking session types and session parameters

Each Progress Dynamics session is started up based on a session type. The session type is the one parameter normally passed in to the startup command using the ICFSESSTYPE parameter of the icfstartup AVM startup option:

In this example, the ICFSESSTYPE used at startup, which is really a logical session type that can have a number of properties of its own, is ICFdev. Look at the session types to see that the physical session type for ICFdev is GUI:

![Session Types](image-url)
Use the `getPhysicalSessionType` function to query the physical session type, as shown:

```
CType = DYNAMIC-FUNCTION('getPhysicalSessionType').
```

These are the possible physical types:

- **APP** — If the `SESSION:CLIENT-TYPE` is APPSERVER, it is an AppServer session.
- **BTC** — If the `SESSION:CLIENT-TYPE` is 4GLCLIENT and `SESSION:BATCH-MODE` is yes, it is a batch client.
- **CUI** — If the `SESSION:CLIENT-TYPE` is 4GLCLIENT and the `SESSION:DISPLAY-TYPE` is "TTY", it is a character client.
- **GUI** — If the `SESSION:CLIENT-TYPE` is 4GLCLIENT and neither of the previous two conditions were met, it is a GUI client.
- **WBC** — If the `SESSION:CLIENT-TYPE` is WBC, it is a WebClient session.
- **WBS** — If the `SESSION:CLIENT-TYPE` is WBS, it is a WebSpeed Transaction Agent.
- If none of the previous conditions have been met, the physical session type is left blank, indicating that the physical session type is unrecognized.

You can also access the values of any of the session properties, or even define new properties of your own, using the `getSessionParam` and `setSessionParam` functions, as shown:  

```
cParamValue = DYNAMIC-FUNCTION('getSessionParam', pcParam).

lResult = DYNAMIC-FUNCTION('setSessionParam', pcParam, pcValue).
```

Here is an example of using these. If you set a parameter that was not defined before, it is defined for you and you can retrieve its value later, as shown in the following example:

```
/* testSessionParam.p -- tests get/setSessionParam and getPhysicalSessionType in the Configuration File Manager. */
DEFINE VARIABLE cSessType AS CHARACTER NO-UNDO.
DEFINE VARIABLE cLocal AS CHARACTER NO-UNDO.
DEFINE VARIABLE cFoobar AS CHARACTER NO-UNDO.
DEFINE VARIABLE cPhysical AS CHARACTER NO-UNDO.

cSessType = DYNAMIC-FUNCTION('getSessionparam', 'icfsesstype').
cLocal = DYNAMIC-FUNCTION('getSessionparam', 'run_local').
cFoobar = DYNAMIC-FUNCTION('getSessionparam', 'foobar').
cPhysical = DYNAMIC-FUNCTION('getPhysicalSessionType').
MESSAGE "ICFSessType is " cSessType SKIP
"Run local is " cLocal SKIP
"New Foobar is " cFoobar SKIP
"Physical Type is" cPhysical.
```
Running this code results in the following **Message** window:

![Message window](image)

For more information about other API calls, see the Configuration File Manager section in *OpenEdge Development: Progress Dynamics Managers API Reference.*

## Using the Connection Manager

The Configuration File Manager starts the Connection Manager during the startup process. In fact, the Configuration File Manager assumes that the Connection Manager is the first manager specified in the managers section of the `ICFCONFIG.XML` file.

The Connection Manager is a universal API that wraps the different types of services so that developers can connect to the services using a standard API.

To provide the specific communication to each type of service, there must be a Service Type Manager procedure for the service. The framework provides a Database Manager, an AppServer Manager, and a JMS Manager for you to take care of communicating with their respective service types. To make a connection to the service, the programmer simply makes a call to the Connection Manager with the name of the service to be connected.

The service types and service connection data are all stored in the database, and those that are required at startup are written to the `ICFCONFIG.XML` file. The Configuration File Manager takes care of calling the Connection Manager to establish the initial connections. The service types are maintained in the **Service Type Control** window under the **Session** menu:

![Service Type Control](image)

When the Session Manager itself starts up, it obtains a complete list of all the services and service types that the session has access to and provides these to the Connection Manager. The Connection Manager only connects to these services upon request.
To communicate with a service:

1. Register the Service Type Manager.

To register the Service Type Manager of the service, the application must start the Service Type Manager as a persistent procedure, and then make a call to the procedure setServiceTypeManager in the Connection Manager. Remember that there is no global variable for the Connection manager, so you must run getManagerHandle to obtain it, as shown:

```
RUN MyService.p PERSISTENT SET hMyService.
RUN getServiceTypeManager IN hConnection (INPUT hMyService).
```

Once the Service Type Manager has been registered, any calls that are made to the Connection Manager are diverted to the appropriate Service Type Manager.

2. Register the service.

To register a service, the application must make a call to registerService in the Connection Manager, passing the handle to a buffer that contains the related data, as shown:

```
RUN registerService IN hConnection (INPUT bMyService).
```

3. Connect to the service.

To connect to a service, the application must call connectService in the Connection Manager, passing the name of the service to be connected, as shown:

```
RUN connectService IN hConnection ('MyService').
```

4. Disconnect from the service.

To disconnect a service, the application calls disconnectService in the Connection Manager, passing the name of the service to be disconnected, as shown:

```
RUN disconnectService IN hConnection ('MyService').
```
5. Interact with the service.

Calls to interact with a service are summarized as follows:

```plaintext
!Connected = DYNAMIC-FUNCTION('isConnected' IN hConnection, 
    pcServiceName AS CHARACTER).
```

```plaintext
cServiceHandle = DYNAMIC-FUNCTION('getServiceHandle' IN hConnection, 
    pcServiceName)
/* Note that the handle is returned as character string */
```

```plaintext
cPhysicalService = DYNAMIC-FUNCTION('getPhysicalService' IN hConnection, 
    pcMyService).
```

```plaintext
cConnectionString = DYNAMIC-FUNCTION('getConnectionString' IN 
    hConnection, pcMyService).
/* This returns the character string needed to connect to the service */
```

```plaintext
cConnectionParams = DYNAMIC-FUNCTION('getConnectionParams' IN 
    hConnection, pcMyService).
/* This returns the connection parameter string as it is stored on the 
    database. */
```

Using the Profile Manager

This section contains an example that enhances the user profile settings for dynamic browsers, allowing column resizing, moving, and sorting to be saved to the Repository as user preferences. Frank Beusenberg of Progress Software Corporation created the original code for this example. This behavior has been integrated into the framework as a standard feature in a slightly different way. It serves as an excellent example of extending the standard objects, their attributes, and their behavior, as well as using the managers to assist you in this.

You already know that the framework saves window sizes and positions for each user. This example allows users to change column sizes, column order, and column sorting, and save these as permanent preferences as well.

This example uses the following Profile Manager calls:

- checkProfileDataExists
- getProfileData
- setProfileData
Using the Progress Dynamics Managers

In addition, it contains some confirmation questions and messages to put up using the \{aferrortxt.i\} message include file, and the askQuestion and showMessages calls from the Session Manager API.

The final result is a pop-up menu, available on browsers where users can select whether selecting a column header should be used to move columns or to sort on a column. They can also save their browser settings or reset to the browser’s original setting:

Creating user profile codes and types

You can create user profile types and codes and extend the set of User Profile Codes and types that are supplied with the framework.

To create user profile types and codes:

1. Choose the Session→Profile Control from the Administration window:

The Profile Control window appears:
2. Click Add. The Profile Maintenance dialog box appears:

3. Type Browser2 for the Profile type code and give it a Profile type description.

4. Leave Client Profile Type checked on, but uncheck Server Profile Type. This combination tells the Profile Manager that this is a code that is maintained on the client side of the profile cache at run time, but not on the server side. This saves the overhead of sending every client setting change back to the server as it is made. All changes are sent back to the server to be written into the database at the end of the session.

5. Leave the Profile Type Active toggle box checked.

6. Save this new Profile Type.

7. Choose the Code tab to add specific codes to the type and click Add:

8. Type Columns for the Profile code and add a Profile Description.

9. Save the new code and click Add again.

10. Type Sorting for the second code and add a description.

11. Save the new code.

12. Choose the Profile Codes tab to see both of your new codes.
13. Exit the **Profile Type Maintenance** window and see your new type added to the list:

![Profile Type Maintenance window](image)

### Creating new browser properties

Now you can start to create the code to support your new feature. This is an extension to the standard browser behavior, so you use the custom files for your changes.

First you must define two new properties that the browser code will need. These are:

- **BrowsePopupActive** — This logical property could be set to disable the pop-up menu so that users can’t change the appearance of a browser.

- **BrowseColumnsMovable** — This logical property indicates whether selecting a column header allows the column to be moved (if the property is TRUE) or allows sorting on the column (if the property is FALSE).

If you were doing this for a standard ADM2 application that is not using Progress Dynamics, you would define these new properties in a custom include file that is part of the class definition. For the browser this is `src/adm2/custom/brspropcustom.i`. You would copy this file to a local directory with the same relative path, and edit it to add your properties, adding the lines shown in bold in the following example to the template code in the main block of the include file:

```plaintext
/* PROPERTY CODE FOR ADM2 NON-DYNAMICS CUSTOMIZATION */
&IF "{"&ADMSuper}":U EQ "":U &THEN
  {src/adm2/custom/brsptocustom.i}
&ENDIF

&GLOBAL-DEFINE xpBrowsePopupActive /* Is the Browse POPUP Menu active? */
&GLOBAL-DEFINE xpBrowseColumnsMovable /* Are the Browse Columns Movable? */

&IF "{"&ADMSuper}":U = "":U &THEN
  ghADMProps:ADD-NEW-FIELD( "BrowsePopupActive":U, "LOGICAL":U, 0, ?, YES ).
  ghADMProps:ADD-NEW-FIELD( "BrowseColumnsMovable":U, "LOGICAL":U, 0, ?, NO ).
&ENDIF
```

The `xp` preprocessors tell the framework that references to the properties can be made directly, by reading the property values out of the temp-table record where they are stored, which is an optimization over running a function to access them. The `ADD-NEW-FIELD` statements add fields to hold the properties to this temp-table, with a data-type of `LOGICAL`, no extent, no specific format, and an initial value of `YES` and `NO`, respectively.
When you recompile the dynamic browser procedure later, these two custom properties would be added to its definition.

However, as explained elsewhere, Progress Dynamics does not use these property include files, neither the standard ones for SmartObject classes nor the custom ones for extended classes. All attributes are defined in the Repository, and it is here that the Progress Dynamics run-time engine looks to assemble the list of all attributes for an object.

For this reason, you do not use the custom property include file to define extended properties for a class. Instead, you simply define them in the Repository. To do this, you must define the attributes and then associate them with the dynamic browser.

To define the attributes:

1. Choose Attributes → Attribute Control from the Development menu. The Attribute Control window appears.

2. Click Add to launch the Attribute Maintenance window:
3. Define the new attributes in turn, as shown in the following table:

<table>
<thead>
<tr>
<th>Option</th>
<th>Attribute 1</th>
<th>Attribute 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute group</td>
<td>Browser</td>
<td>Browser</td>
</tr>
<tr>
<td>Attribute label</td>
<td>BrowsePopupActive</td>
<td>BrowseColumnsMovable</td>
</tr>
<tr>
<td>Data type</td>
<td>Logical</td>
<td>Logical</td>
</tr>
<tr>
<td>Constant level</td>
<td>Instance Level</td>
<td>Instance Level</td>
</tr>
<tr>
<td>Lookup type</td>
<td>Free Text</td>
<td>Free Text</td>
</tr>
</tbody>
</table>

Note that the object types list in this window is not enabled for input. This displays the object types the attribute has been added to, but is not directly updateable. After you complete the next step of adding the attributes to a custom version of the DynBrow class, then you can return to this window and verify that the custom class is shown as the object type for the attributes.

4. Save each of the two new attributes in turn. Then, exit the maintenance window.

5. When you return to the Attribute Control browse, click Refresh to see the two new browser attributes along with all the standard ones:

![Attribute Control](image)

Although you have put the new attributes into the browser group, this is only an informal grouping. Next, you must follow these steps to add them explicitly to the DynBrow class for the dynamic browser so that they are added to the object attributes at run time.
6. Choose **Build→Class Maintenance** to launch the **Class Maintenance** window.

7. Type **DynBrow** in the **Class** field and click **Find**. The treeview expands to the proper node:

![Class Maintenance window](image)

As noted elsewhere, the hierarchy of this object type TreeView does not fully represent the hierarchy of classes for every object type, as some classes (such as AppServer) are only used optionally or only used by a subset of the objects at that level.

8. Choose the **Attributes** tab and click **Add** in the upper toolbar:

![Attributes tab](image)
9. Type `BrowsePopupActive` in the **Attribute** column. Note that a selection list appears with valid attributes as you begin to type. As you type, the list filters down. The following dialog box appears:

![Dialog box](image)

10. Click **Yes**. The **Custom class name** dialog box appears:

![Dialog box](image)

11. Type `Browse2` as the Response and click **OK**:

![Dialog box](image)

12. Select **YES** as the **Value** and save your changes.

13. Click **Add** and add the **BrowseColumnsMovable** attribute.

14. Select **YES** as the **Value** and save your changes.

Now your two new attributes will be added to each new dynamic browser as it is created at run time.
Creating a custom super procedure for the browser

Next, you must activate the custom super procedure that extends the browser class. Copy the file src/adm2/custom/browsercustom.i to a local directory with the same relative pathname, and edit it to remove the comments around the start-super-proc statement that starts browsercustom.p, as shown:

```plaintext
/* ************************************** Main Block ************************************** */
/* Starts here the custom super procedure
   Uncomment to run it */
```

Add the supporting code for the pop-up menu. Copy the file src/adm2/custom/browsercustom.p to a local directory with the same relative path. The remainder of this section highlights key parts of the code that must be added to the super procedure. A complete version of the code is available in the browsercustom_popup.p file that accompanies this documentation. You can refer to this procedure for more code details and run it (after renaming it, of course) to try out the feature.

The first requirement is that there must be functions that support getting and setting the two new properties you just defined. As we noted, the xp preprocessors you defined allow code within the super procedure itself, or in other super procedures in the browser support code, to access the property directly in the property temp-table record for the object. This is done using the \{get\} and \{set\} include files that you’ve seen elsewhere in this documentation. The include files access the property without using a function call, which is a small optimization.

But other objects cannot use this convention because they do not have access to the temp-table record directly. So you must define \get\ and \set\ functions for every property that should be retrievable or settable from outside the object itself and its supporting code.

The form of these functions is simple. The following code sample is the \get\ function for the BrowsePopupActive property:

```plaintext
FUNCTION getBrowsePopupActive RETURNS LOGICAL
  () :
  /*-------------------------------------------------------------------------
  Purpose: Returns the value of the BrowsePopupActive property.
  ------------------------------------------------------------------------*/
  DEFINE VARIABLE lActive AS LOGICAL NO-UNDO.
  \{get BrowsePopupActive lActive\}.
  RETURN lActive.
END FUNCTION.
```
As you can see, it simply turns around and accesses the property via the \{get\} include file, which is available to it because it is within the class hierarchy for the object, where the include files can be used. The \texttt{set} property function is similar, as shown:

```plaintext
FUNCTION setBrowsePopupActive RETURNS LOGICAL
( INPUT plActive AS LOGICAL ):
/*-----------------------------------------------*/
Purpose: Sets the BrowsePopupActive property.-----------------------------------------------*/

   {set BrowsePopupActive plActive}.

RETURN TRUE.
END FUNCTION.
```

You need equivalent functions for the \texttt{BrowseColumnsMovable} property as well.

**Customizing the initializeObject procedure**

The next piece of code you need is a localization of the \texttt{initializeObject} procedure. This should first invoke the standard behavior with a \texttt{RUN SUPER} statement, as shown:

```plaintext
/* Run default behavior first. */
RUN SUPER.
```

Next, it retrieves the \texttt{BrowsePopupActive} property value and creates the pop-up menu if the property hasn’t been set to \texttt{FALSE}, as shown:

```plaintext
{get BrowsePopupActive lPopupActive}.
IF lPopupActive THEN
   RUN createBrowsePopupMenu ( INPUT TARGET-PROCEDURE ).
```

**Note:** The code excerpts here are not complete. All variable references, for example, are defined in the procedure or function where they are used. See the accompanying procedure file for the complete code.
Before looking at the `createBrowsePopupMenu` procedure, the code must identify the key under which the profile values are stored. In order to allow you to customize a browser’s appearance differently in different container windows, the container’s name and the logical browser name are combined to form the key. If the container does not have a `LogicalObjectName` property value, then it is presumably a static container, so the procedure handle’s `FILE-NAME` is used instead, as shown:

```hll
/* Create the ProfileKey. */
{get ContainerSource hContainerSource}.
IF VALID-HANDLE( hContainerSource ) THEN
  {get LogicalObjectName cContainerName hContainerSource} NO-ERROR.
ELSE
  cContainerName = "".
ENDIF

IF ( cContainerName = "" ) AND VALID-HANDLE( hContainerSource ) THEN
  cContainerName = hContainerSource:FILE-NAME.
ENDIF

cProfileKey = cContainerName + cBrowserName.
```

### Using checkProfileDataExists and getProfileData

Now you are ready to access the Profile Manager itself. Use a call to see whether profile data is defined for the profile code and key, as shown:

```hll
/* Try to restore column settings. Check the Profile Manager if the profile data we're looking for actually exists... */
RUN checkProfileDataExists IN gshProfileManager ( 
  INPUT "Browser",
  INPUT "Columns",
  INPUT cProfileKey,
  INPUT YES,
  INPUT NO,
  OUTPUT lProfileExists ).
```

The syntax for the `checkProfileDataExists` call is:

```hll
RUN checkProfileDataExists IN gshProfileManager ( 
  INPUT pcProfileTypeCode,
  INPUT pcProfileCode,
  INPUT pcProfileDataKey,
  INPUT plCheckPermanentOnly,
  INPUT plCheckCacheOnly,
  OUTPUT plExists     ).
```

These are its parameters:

- **`INPUT pcProfileTypeCode` (CHARACTER)** — This is the code for the profile information type that you defined in the User Profile Code maintenance utility, browsers in the case of this example.

- **`INPUT pcProfileCode` (CHARACTER)** — This is the subcode for the type that you also defined in the User Profile Code utility. You created profile codes for Columns and Sorting for the example.
• **INPUT pcProfileDataKey (CHARACTER)** — This is whatever key you wish to define for storing and retrieving data for a particular code. In the case of the example, it’s the container name plus the browser name.

• **INPUT plCheckPermanentOnly (LOGICAL)** — This flag tells the Profile Manager whether it should look only for settings marked as being permanent, as opposed to settings that are being saved for the session only. This is normally a settable user preference, although in our somewhat simplified example, browser settings are always saved as Permanent, as you will see later.

• **INPUT pcCheckCacheOnly (LOGICAL)** — If this logical flag is set to TRUE, then only the currently cached data will be searched for the settings. If it’s FALSE, then the database table will also be checked if the setting is not found in the cache.

• **OUTPUT plExists (LOGICAL)** — This returned value tells you whether the profile data you want is defined or not. In the example, there should be profile data for the key if this user had previously saved browser settings for this browser in this container, otherwise not.

If there is already profile data for the combination of user, container, and browser, then the next call retrieves it, as shown:

```plaintext
IF !ProfileExists THEN
   DO:
      ASSIGN rRowID = ?.
      RUN getProfileData IN gshProfileManager ( 
         INPUT "Browser", 
         INPUT "Columns", 
         INPUT cProfileKey, 
         INPUT NO, 
         INPUT-OUTPUT rRowID, 
         OUTPUT cProfileData ).
```

The syntax for the getProfileData call is:

```plaintext
RUN getProfileData IN gshProfileManager 
   ( INPUT pcProfileTypeCode, 
     INPUT pcProfileCode, 
     INPUT pcProfileDataKey, 
     INPUT plNextRecordFlag, 
     INPUT-OUTPUT prRowID, 
     OUTPUT pcProfileData ).
```

The getProfileData procedure has these parameters:

• **INPUT pcProfileTypeCode (CHARACTER)** — As in the previous function.

• **INPUT pcProfileCode (CHARACTER)** — As in the previous function.

• **INPUT pcProfileDataKey (CHARACTER)** — As in the previous function.
• **INPUT p1NextRecordFlag (LOGICAL)** — The getProfileData procedure can be used in some cases to walk through all profile records matching the combination of profile type code, profile code, and data key passed in. You can omit one or more of these parameters if you want to retrieve all records matching a partial set of keys. In such a case, getProfileData returns the profile data from one record at a time. In order to retrieve all the records, you must call getProfileData with the NextRecordFlag set to NO on the first call, and then continue to call it with the NextRecordFlag set to YES until an Unknown value (?) in the RowID parameter described next indicates that there are no more matching records. To retrieve a single data value, set this parameter to NO.

• **INPUT-OUTPUT prRowID (ROWID)** — getProfileData always returns the RowID of the record that supplied the profile data, using this INPUT-OUTPUT parameter. If you are walking through a set of records, then you must pass the current RowID back in with each call after the first one, along with a NextRecordFlag of YES. If you only want to retrieve a single profile data value matching the three key values for Type Code, Profile Code, and Profile Key, then you must pass in the Unknown value (?) for this parameter; otherwise the Profile Manager will ignore the first three key value parameters and use the RowID as the basis for the request. If this parameter comes back as the Unknown value (?), then there was no matching record (or no next record if NextRecordFlag was YES).

• **OUTPUT pcProfileData (CHARACTER)** — You can store any meaningful character string you want as the data associated with a profile key. This parameter returns it to you.

In its search for your profile data, getProfileData first looks in the client cache if it’s running client side. If the data is not found and this is not a cached profile type, it looks in the database. The procedure always checks for session data first, then permanent data. If a RowID is passed in, then this is used to find the record. The RowID is the RowID of the temp-table if this is a client-only profile type; otherwise it is the RowID of the database record.

Profile types are either maintained completely using the client cache or always read from the database. When trying to get profile data, the procedure first fully caches the entire profile type if it is not already cached and this is a client-only profile type. Normally the full cache is built at application start-up, but profile types can be cached as used.

The initializeObject procedure now has the profile data for this user, container, and browser, if it has been previously saved. If there is data, then the code manipulates the order and size of each browse column accordingly. Because this code is not pertinent to our study of the Profile Manager, just a couple of key lines are reproduced here, as shown:

```plaintext
... hBrowse:MOVE-COLUMN( iColumnPosition, iLoop ).
hColumn:WIDTH-PIXELS = INTEGER ( ENTRY( 2, cColumnEntry, CHR(4) ) ).
...```

Refer to the procedure file for the complete code example.
Next, the code makes similar calls to checkProfileDataExists and getProfileData for data under the Sorting code. If a sort setting comes back, then it resets the query's sort sequence accordingly, and reopens the SDO's query. Note that the SDO is the Data-Source for the browser, so following that link identifies the procedure where the query must be reset and reopened. The REFRESHABLE attribute setting keeps the Browse from flashing as it is being manipulated, as shown:

```
hBrowse:REFRESHABLE = NO.
DYNAMIC-FUNCTION( "setQuerySort":U IN hDataSource, cProfileData ).
DYNAMIC-FUNCTION( "openQuery":U IN hDataSource ).
hBrowse:REFRESHABLE = YES.
```

### Creating the Pop-up menu

The initializeObject procedure calls createBrowsePopupMenu unless the menu has been disabled. This custom procedure creates the menu and its menu items as dynamic ABL objects.

The first thing to examine is why it is necessary to pass in the procedure handle of the browser object as an INPUT parameter. The call to createBrowsePopupMenu in initializeObject looks like the following:

```
RUN createBrowsePopupMenu ( INPUT TARGET-PROCEDURE ).
```

The called procedure defines it as an INPUT parameter to be used later in the code, as shown:

```
DEFINE INPUT  PARAMETER hTarget     AS HANDLE     NO-UNDO.
```

So why can't createBrowsePopupMenu just reference TARGET-PROCEDURE directly, as you have seen in many other cases? For the answer, refer back to the discussion and diagrams in Chapter 1, “Writing Super Procedures for Objects.” There we explained that in order for any internal procedure to refer to TARGET-PROCEDURE successfully, it must itself be run IN TARGET-PROCEDURE. In this case, because createBrowsePopupMenu is in the same procedure file as the initializeObject procedure that calls it, the RUN statement just makes the call directly. For this reason, a reference to TARGET-PROCEDURE within createBrowsePopupMenu evaluates to the handle of the super procedure browsercustom.p, not to the browser SmartObject instance itself, and this is not what the code needs. Thus, either the TARGET-PROCEDURE handle must be passed in as an argument or the RUN statement must bounce back to browsercustom.p by being formulated as RUN createBrowsePopupMenu IN TARGET-PROCEDURE. Either technique works.

The code first creates the menu object itself, as shown:

```
CREATE MENU hPopupMenu
ASSIGN POPUP-ONLY  = TRUE
        TITLE      = "Browser Menu".
```
It then creates each of the following menu items:

```
CREATE MENU-ITEM hColsMovableItem
  ASSIGN PARENT = hPopupMenu
  LABEL = "&Move Columns"
  NAME = "ColsMovable"
  TOGGLE-BOX = TRUE
  CHECKED = FALSE.
Etc.
```

Again, see the accompanying procedure file for the complete code.

Next, the procedure attaches the menu to the browse widget handle, which it has retrieved using the `BrowseHandle` property of the browser object. Just to clarify, the `BrowseHandle` is the widget handle of the browse control itself. The `hTarget` parameter passed in to the procedure is the `procedure` handle of the browser SmartObject instance, as shown:

```
/* Add POPUP Menu to the Browse Widget. */

hBrowse:POPUP-MENU = hPopupMenu.
```

Finally, the code defines trigger procedures for the `MENU-DROP` event of the menu itself, the `VALUE-CHANGED` event of the Movable Item and Sortable Item, which control the check marks on those items, and the `CHOOSE` event for the Save and Reset options. The `PERSISTENT RUN` syntax is required to associate an internal procedure such as `eventMenuItemValueChanged` with a dynamic menu item, as shown:

```
ON MENU-DROP OF hPopupMenu
  PERSISTENT RUN eventPopupMenuMenuDrop IN hTarget ( INPUT hPopupMenu ).
ON VALUE-CHANGED OF hColsMovableItem
  PERSISTENT RUN eventMenuItemValueChanged IN hTarget ( INPUT hColsMovableItem ).
ON VALUE-CHANGED OF hColsSortableItem
  PERSISTENT RUN eventMenuItemValueChanged IN hTarget ( INPUT hColsSortableItem ).
ON CHOOSE OF hSaveItem
  PERSISTENT RUN eventMenuItemChoose IN hTarget ( INPUT hSaveItem ).
ON CHOOSE OF hResetItem
  PERSISTENT RUN eventMenuItemChoose IN hTarget ( INPUT hResetItem ).
```

Note that it is important for the trigger definitions to specify that the event procedure is run IN `TARGET-PROCEDURE`. Because `TARGET-PROCEDURE` itself is not available here, as noted, they do this using the procedure handle `hTarget` that was passed in as a parameter. In this way, the individual trigger procedures can correctly reference `TARGET-PROCEDURE` themselves.
Defining the Pop-up menu event procedures

There are several procedures that respond to menu events, including:

- Menu Item Choose procedure and using messages in the Message table.
- Using the Session Manager’s askQuestion procedure.
- Using the setProfileData procedure.
- Using the SessionManager’s showMessages procedure.
- Changing the browser’s COLUMN-MOVABLE attribute.
- Setting the pop-up menu’s state on menu drop.
- Testing the extended browser profile data.

Menu Item Choose procedure and using messages in the Message table

The eventMenuItemChoose procedure is run when the Save or Reset menu item is chosen. As part of this process, four different messages are used to interact with the user. Two are questions confirming the intent to Save or Reset settings, and the other two are confirmation messages that the Save or Reset succeeded. It is questionable whether either the questions or the confirmation are really appropriate to the user interface, since saving column size and position preferences is not such a major operation that the user should necessarily be forced to OK two message boxes to complete the request. The messages are here more to demonstrate how to use the Session Manager’s message support in your own application code.

To make messages reusable and translatable:

1. Choose System→Message Control in the Administration window:
2. Click Add to bring up Message Maintenance for a new message:

Each message has a two-part key consisting of a message group and a message number within the group. To keep the new messages distinct from standard system messages, you can put them in a new group, such as BR.

3. Type BR for Group and a 1 for Number.

4. Set the default language and select Source Language. At least one message in a group must indicate the source language for that group. For subsequent messages, you need only select Source Language.

5. Type Save Browser settings? as the Message Summary Description and a longer message in the editor box.

6. Select Question as the Message Type.

7. Type a complete explanation for the Message full description and save your message.

8. Add messages with the following properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Message 2</th>
<th>Message 3</th>
<th>Message 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Message group</td>
<td>BR</td>
<td>BR</td>
<td>BR</td>
</tr>
<tr>
<td>Message number</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Source language</td>
<td>Selected</td>
<td>Selected</td>
<td>Selected</td>
</tr>
<tr>
<td>Message type</td>
<td>Question</td>
<td>Information</td>
<td>Information</td>
</tr>
</tbody>
</table>

**Note:** You also need to add text for the Message full description.

9. Save each message and then exit the maintenance window.
10. Type BR for the Error group and click Refresh to filter the Message Control window to display all your new messages:

Now you can use the messages in your application. The code retrieves the browse settings question, if the menu item chosen was SaveBrowseSettings, using the {aferrortxt.i} include file. For more information see OpenEdge Development: Progress Dynamics Basic Development. If the menu item is Reset, then message 2 is retrieved instead, as shown:

IF ( hMenuItem:NAME = "SaveBrowseSettings" ) THEN DO:
   ASSIGN cMessage = {aferrortxt.i 'BR' '1'} /* "Save browser settings?" */
   lDeleteProfileEntry = FALSE.
   ... etc.

Using the Session Manager’s askQuestion procedure

This text is passed to the Session Manager’s askQuestion procedure to present the question to the user. Note that the message text returned by aferrortxt.i is specially formatted to be used by either the askQuestion and showMessage procedures or the checkerr.i include file (which is also described in OpenEdge Development: Progress Dynamics Basic Development).

Its format is not appropriate to display directly to the user, as shown:

/* Ask user for save or reset confirmation. */
RUN askQuestion IN gshSessionManager ( 
   INPUT cMessage, 
   INPUT "OK,Cancel", 
   INPUT "OK", 
   INPUT "Cancel", 
   INPUT ",", 
   INPUT ",", 
   INPUT ",", 
   INPUT-OUTPUT cAnswer, 
   OUTPUT cButtonPressed). 
/* Only continue this if user pressed the "OK" button. */
IF ( cButtonPressed <> "OK" ) THEN RETURN.
This call puts up a message box with OK and Cancel buttons, where OK is the default on Return and Cancel is the default on Escape, and gets back the name of the button the user pressed. If this isn’t the OK button, then the procedure just returns.

The askQuestion call takes these parameters:

```
RUN askQuestion IN gshSessionManager
  ( INPUT pcMessageList,
    INPUT pcButtonList,
    INPUT pcDefaultButton,
    INPUT pcCancelButton,
    INPUT pcMessageTitle,
    INPUT pcDataType,
    INPUT pcFormat,
    INPUT-OUTPUT pcAnswer,
    OUTPUT pcButtonPressed    ).
```

- **INPUT pcMessageList (CHARACTER)** — This is a specially formatted message to display.
- **INPUT pcButtonList (CHARACTER)** — This is a list of the buttons that should appear in the message dialog box.
- **INPUT pcDefaultButton (CHARACTER)** — This is the default button to fire if the user presses RETURN instead of selecting a button.
- **INPUT pcCancelButton (CHARACTER)** — This is the button to fire if the user presses ESCAPE instead of selecting a button.
- **INPUT pcMessageTitle (CHARACTER)** — This optional argument is the title that should appear in the message dialog box. The default is Question.
- **INPUT pcDataType (CHARACTER)** — This optional argument is the data type of the answer to the question, if one is requested.
- **INPUT pcFormat (CHARACTER)** — This optional argument is the format of the answer to the question.
- **INPUT-OUTPUT pcAnswer (CHARACTER)** — The question dialog can, if needed, prompt the user for an answer to the question it poses. This parameter returns the answer to the question being asked. If a nonblank value is passed in, it will be used as an initial answer value. If the data type and format are blank, then no response will be requested and only the button selected with a blank answer will be returned.
- **OUTPUT pcButtonPressed (CHARACTER)** — This is the label of the button that was selected (explicitly or by default if the user pressed RETURN or ESCAPE). If there is no explicit answer to the question, as defined in the pcAnswer, pcDataType, and pcFormat arguments, then the button pressed is effectively the user’s answer. If the button labels are passed in with an ampersand (&), then the button pressed will also contain the ampersand when returned, so you will need to check for this.
If the session is running on the server-side, messages cannot be displayed. Instead they are written to the message log. On the server side, there is no user interface, so the default button label and answer are always returned. On the client side, the messages are displayed in a dialog window. The procedure checks the suppressDisplay property in the Session Manager, and if this is set to YES, it does not display the message but simply passes the message to the log as would be the case for a server-side message. This is useful when your application is running take-on or bulk load procedures client-side.

The askQuestion call in the example looks like this at run time:

![Image of a dialog window with a question and buttons]

**Using the setProfileData procedure**

The code then gathers up the browse settings for column order and column widths and passes it to the Profile Manager using the procedure setProfileData, as shown:

```plaintext
/* Save column settings to user profile. */
ASSIGN rRowID = ?.
RUN setProfileData IN gshProfileManager (    
    INPUT "Browser",     
    INPUT "Columns",     
    INPUT cProfileKey,     
    INPUT rRowID,     
    INPUT cColumnData,     
    INPUT 1DeleteProfileEntry,     
    INPUT "PER" ).
```

The setProfileData procedure has the following syntax:

```plaintext
RUN setProfileData IN gshProfileManager
( INPUT pcProfileTypeCode,    
  INPUT pcProfileCode,    
  INPUT pcProfileDataKey,    
  INPUT prRowid,    
  INPUT pcProfileDataValue,    
  INPUT p1DeleteFlag,    
  INPUT pcSaveFlag).
```

The setProfileData procedure takes these parameters:

- **INPUT pcProfileTypeCode (CHARACTER)** — As in the previous function.
- **INPUT pcProfileCode (CHARACTER)** — As in the previous function.
- **INPUT pcProfileDataKey (CHARACTER)** — As in the previous function.
- **INPUT prRowid (ROWID)** — As above; if this is passed in, the first three arguments do not apply (and they will be ignored if they are specified).
• **INPUT pcProfileDataValue (CHARACTER)** — This is the character string to assign as the data for this profile entry. The format and content are up to the application that defines and uses the profile code.

• **INPUT plDeleteFlag (LOGICAL)** — If this is TRUE, then the profile data for the matching code will be deleted rather than set. In the case of the example, this value corresponds to the variable lDeleteProfileEntry, which is TRUE is the user selected Reset, and FALSE if the user selected Save.

• **INPUT pcSaveFlag (CHARACTER)** — This parameter should be set to either PER, to mark the settings as Permanent, or SES to save them for the duration of the session only. If the save flag is set to Session, then the user’s session ID is stored in the profile table’s context id field, otherwise the field is left blank to indicate a permanent value.

Note that setProfileData can be used to either set or clear profile data for multiple records that match a partial key passed in. If either one or two of the first three parameters are passed in, but not all three, then all matching profile records are set to the specified profile data value, or they are deleted if the Delete Flag is set.

Back in the example code, the same setProfileData operation is then done for the sorting profile code and the current sort sequence.

**Using the SessionManager's showMessages procedure**

Finally, the code retrieves the appropriate confirmation message that the operation succeeded and displays it to the user using the Session Manager’s showMessages procedure, as shown:

```/* Show message to user indicating action has been taken. */
IF NOT lDeleteProfileEntry THEN
   /* "Saving browser settings succeeded!" */
   ASSIGN cMessage = {aferrortxt.i 'BR' '3'}.
ELSE
   /* "Resetting browser settings succeeded!" */
   ASSIGN cMessage = {aferrortxt.i 'BR' '4'}.
RUN showMessages IN gshSessionManager (  
   INPUT cMessage,  
   INPUT "INF",  
   INPUT "OK",  
   INPUT "OK",  
   INPUT "",  
   INPUT "Browser Settings",  
   INPUT NO,  
   INPUT ?,  
OUTPUT cButtonPressed ).```
The syntax for `showMessages` is as follows:

```plaintext
RUN showMessages IN gshSessionManager
  ( INPUT  pcMessageList
  INPUT  pcMessageType
  INPUT  pcButtonList
  INPUT  pcDefaultButton
  INPUT  pcCancelButton
  INPUT  pcMessageTitle
  INPUT  plDisplayEmpty
  INPUT  phContainer
  OUTPUT pcButtonPressed).
```

These are the parameters for `showMessages`:

- **INPUT pcMessageList (CHARACTER)** — This is the specially formatted message to display. This can also be a `CHR(3)`-delimited list of messages.

- **INPUT pcMessageType (CHARACTER)** — This can be any of the various message types except for the special `Question` type, including `Message (MES)`, `Information (INF)`, `Warnings (WAR)`, `Errors (ERR)`, `Serious Halt Errors (HAL)` and `About Window (ABO)`.

- **INPUT pcButtonList (CHARACTER)** — This is a list of the buttons that should appear in the message dialog box.

- **INPUT pcDefaultButton (CHARACTER)** — This is the default button to fire if the user presses `RETURN` instead of selecting a button.

- **INPUT pcCancelButton (CHARACTER)** — This is the button to fire if the user presses `ESCAPE` instead of selecting a button.

- **INPUT pcMessageTitle (CHARACTER)** — This optional argument is the title that should appear in the message dialog box.

- **INPUT plDisplayEmpty (LOGICAL)** — This flag indicates whether the message dialog box should be displayed even if the message text is empty.

- **INPUT phContainer (HANDLE)** — This is the handle of the container the message dialog box is running from.

- **OUTPUT pcButtonPressed (CHARACTER)** — This returns the label of the button the user selected.

Our sample code results in the following message dialog box:

![Message Dialog Box](image_url)
Changing the browser’s COLUMN-MOVABLE attribute

The procedure eventMenuItemValueChanged is called if the user changes one of the two check-marked menu items (Movable and Sortable). It sets the browser widget’s COLUMN-MOVABLE attribute accordingly. Setting COLUMN-MOVABLE to TRUE allows you to move browse columns by selecting the header, and disables automatic column sorting, as shown:

```lisp
/* Set COLUMN-MOVABLE off if the Menu Item was "sortable" */
lValue = hMenuItem:CHECKED.
IF ( hMenuItem:NAME = "ColsSortable" ) THEN
  lValue = NOT lValue.
{set BrowseColumnsMovable lValue}.
hBrowse:COLUMN-MOVABLE = lValue.
```

Setting the pop-up menu’s state on menu drop

The eventPopupMenuMenuDrop procedure is called whenever the user brings up the pop-up menu by right-clicking on the browse. It checks the value of the BrowseColumnsMovable property and sets the two check-marked menu items accordingly, as shown:

```lisp
{get BrowseColumnsMovable lMovable}.
IF ( hMenuItem:NAME = "ColsMovable" ) THEN
  hMenuItem:CHECKED = lMovable.
ELSE IF ( hMenuItem:NAME = "ColsSortable" ) THEN
  hMenuItem:CHECKED = NOT lMovable.
```

Testing the extended browser profile data

To see what the effect of this custom code is:

1. Recompile the procedure ry/obj/rydynbrowb.w, the framework’s dynamic browser. Run any container with a dynamic browser in it, for instance, the Customer browser:
2. Bring up the pop-up menu. You can sort on any column by selecting its header. You can resize columns and the new widths will be saved. You can choose the Move Columns menu item, grab a column by its header, and move it to a new position:

3. Choose Save Browser Settings from the menu to save your changes to the Repository so the container looks the same the next time you run it.

Using the Localization Manager

The Localization Manager handles text translations and other localization support. OpenEdge Getting Started: Installation and Configuration has a section on translating the labels on a window, which introduces the User Interface that makes use of the Localization Manager. In addition, the message maintenance utility lets you translate messages such as those you just created into other languages.

The following section introduces you to a few of the API calls you can use to adapt the Localization Manager for more specialized needs. Specifically, our pop-up menu example has one weakness where localization is concerned: the pop-up menu is not a standard Progress Dynamics object, and its labels are hard-coded in the browsercustom.p file, which prevents it from being translated. So in this section you define translations for the pop-up menu item labels and then access them through the Localization Manager API.

Storing translated text strings in the Repository

You can create a translation by storing individual text strings in the Repository.

To create the translations:

1. Choose Application→Language Control in the Administration window to create a new language. If you have been through the tutorial or have defined multiple languages for any other purpose, you already have languages other than English defined in the Repository.

2. Click Add in the Translation Control browse window and add translations for each of the text strings in the pop-up menu.

3. To translate text strings not associated with a specific Progress Dynamics widget type, select the language you are translating into.

4. Select Text as the Widget Type and enter the base string (in the original language) in the Widget Name field.
5. Enter the translated text in the **Translation label** field:

![Translation Maintenance window](image)

6. Save this and enter four more text translations for **Sort Columns**, **Save Browser Settings**, **Reset Browser Settings**, and **Exit**. When you are done, exit the maintenance window to see your translations in the **Translation Control** browse.

7. Now choose **File→Re-Logon** from the AppBuilder menu and log back in using your **Login Name**, but with the **Language** set to **French**:

![Re-Logon window](image)

---

**Using the API calls translatePhrase and getTranslation**

Use the `translatePhrase` function call to access a text translation. This function returns translations for base text strings one at a time, as shown:

```plaintext
DYNAMIC-FUNCTION("translatePhrase":U IN gshTranslationManager, 
    INPUT pcText, 
    INPUT pdLanguageObj )
```

The `translatePhrase` function takes these parameters:

- **INPUT pcText (CHARACTER)** — The base text string (in the original language) that you want to have translated.

- **INPUT pdLanguageObj (DECIMAL)** — The object ID key of the Language table record for the language to be translated into. You can retrieve this object ID, if you need it, using the `currentLanguageObj` property, which the Session Manager maintains and can return to you with the `getPropertyList` API call.

- **RETURNS (CHARACTER)** — The function returns the translated string.
The translatePhrase function is basically a simplified version of the getTranslation call, which you can use when you need more than text strings translated, as shown:

```java
RUN getTranslation IN gshTranslationManager
   ( INPUT pdLanguageObj,
     INPUT pcObjectName,
     INPUT pcWidgetType,
     INPUT pcWidgetName,
     INPUT pdWidgetEntry,
     OUTPUT pcOriginalLabel,
     OUTPUT pcTranslatedLabel,
     OUTPUT pcOriginalTooltip,
     OUTPUT pcTranslatedTooltip )
```

The getTranslation procedure takes these parameters:

- **INPUT pdLanguageObj (DECIMAL)** — The object ID of the Language table record identifying the target language. The default is 0 for the current login language.

- **INPUT pcObjectName (CHARACTER)** — The name of the application object being translated. This can be an actual object name or it can be blank, in which case the translation that applies to all objects of the widget type (in effect the default value) is returned. This field should also be blank if you’re retrieving a text translation.

- **INPUT pcWidgetType (CHARACTER)** — This can be one of the following strings: title, browse, fill-in, radio-set, text, button, toggle-box, combo-box, slider, or editor. Setting the widget type and widget name both to title is a special case for window title translation.

- **INPUT pcWidgetName (CHARACTER)** — A window title, a text value, or a widget label.

- **INPUT pdWidgetEntry (INTEGER)** — The widget entry number is used for radio set items.

- **OUTPUT pcOriginalLabel (CHARACTER)** — The widget label in the original language is returned in this OUTPUT parameter.

- **OUTPUT pcTranslatedLabel (CHARACTER)** — The translated widget label is returned in this OUTPUT parameter. Text translations are also returned in this parameter.

- **OUTPUT pcOriginalTooltip (CHARACTER)** — If this is a widget that supports ToolTips, the ToolTip in the original language is returned in this OUTPUT parameter.

- **OUTPUT pcTranslatedTooltip (CHARACTER)** — The ToolTip translation, if any, is returned in this OUTPUT parameter.

### Using multiTranslation and the translation temp-table

If you have a large number of strings that you want to translate in a single call, use the multiTranslation API call, as shown:

```java
RUN multiTranslation IN gshTranslationManager
   ( INPUT plAllLanguages,
     INPUT-OUTPUT TABLE ttTranslate ).
```
The multiTranslation call takes two parameters:

- **INPUT plAllLanguages (LOGICAL)** — TRUE if records should be returned for every language an input string has been translated into, otherwise FALSE. If TRUE, then extra records are created in the temp-table for each language available. The temp-table must, in that case, initially contain entries with a language object ID of 0. These are deleted in the temp-table that is returned, which, instead, contains a record for the translation into each language.

- **INPUT-OUTPUT TABLE ttTranslate** — The ttTranslate temp-table is defined in the include file af/app/aftttranslate.i. This temp-table definition is used by the Localization Manager itself, and you can define a temp-table based on it as well as for calls such as multiTranslation.

These are the fields in the table:

```sql
&IF DEFINED(ttTranslate) = 0 &THEN
    DEFINE TEMP-TABLE ttTranslate NO-UNDO RCODE-INFORMATION
    FIELD dLanguageObj AS DECIMAL  /* language object or 0 for login language */
    FIELD cLanguageName AS CHARACTER FORMAT "X(20)" :U LABEL "Language" :U  /* language name if known */
    FIELD cObjectName AS CHARACTER FORMAT "X(40)" :U LABEL "Object Name" :U  /* object name or blank for all */
    FIELD lGlobal AS LOGICAL FORMAT "YES/NO" :U LABEL "Global" :U  /* yes = global translation, no = specific object (if not blank) */
    FIELD cWidgetType AS CHARACTER FORMAT "X(20)" :U LABEL "Widget Type" :U  /* widget type, e.g. text, button, etc. */
    FIELD cWidgetName AS CHARACTER FORMAT "X(40)" :U LABEL "Widget Name" :U  /* widget name or if type is text, text to translate */
    FIELD hWidgetHandle AS HANDLE  /* handle of widget if known / required */
    FIELD iWidgetEntry AS INTEGER FORMAT "9" :U LABEL "Element" :U  /* widget entry, used for radio-sets, etc. */
    FIELD lDelete AS LOGICAL FORMAT "YES/NO" :U LABEL "Delete" :U  /* yes = global translation, no = specific object (if not blank) */
    FIELD cTranslatedLabel AS CHARACTER FORMAT "X(30)" :U LABEL "Translated Label" :U  /* translated label */
    FIELD cOriginalLabel AS CHARACTER FORMAT "X(30)" :U LABEL "Original Label" :U  /* original untranslated label */
    FIELD cTranslatedTooltip AS CHARACTER FORMAT "X(40)" :U LABEL "Translated Tooltip" :U  /* translated tooltip */
    FIELD cOriginalTooltip AS CHARACTER FORMAT "X(40)" :U LABEL "Original Tooltip" :U  /* original untranslated tooltip */
    INDEX key1 AS UNIQUE PRIMARY dLanguageObj cObjectName cWidgetType cObjectName hWidgetHandle iWidgetEntry cTranslatedLabel
    INDEX key2 cLanguageName cObjectName cWidgetType cObjectName iWidgetEntry cTranslatedLabel
    INDEX key3 cObjectName cWidgetType cObjectName iWidgetEntry cTranslatedLabel
    INDEX key4 cWidgetName iWidgetEntry cObjectName cWidgetType
    &GLOBAL-DEFINE ttTranslate
&ENDIF
```
These fields should be familiar to you if you have seen the parameter list for `getTranslation`.

To use the Translation temp-table, first define it in the custom super procedure and then populate it:

1. Include the definition in the **Definitions** section of `browsercustom.p`, as shown:

```plaintext
{af/app/aftttranslate.i}
```

2. Populate the table in `createBrowsePopupMenu` to pass it in to `multiTranslation`. Define a variable with the text strings you need, and a counter variable to walk through them, as shown:

```plaintext
DEFINE VARIABLE cStrings AS CHARACTER NO-UNDO
INIT "Move Columns,Sort Columns,Save Browser Settings,Reset Browser Settings,Exit".
DEFINE VARIABLE iString AS INTEGER NO-UNDO.
```

3. Populate the temp-table with records for each of the strings needing translation, as shown:

```plaintext
DO iString = 1 TO NUM-ENTRIES(cStrings):
  CREATE ttTranslate.
  ASSIGN ttTranslate.dLanguageObj = 0 /* Use the login language */
    ttTranslate.cObjectName = ""
    ttTranslate.lGlobal = NO
    ttTranslate.cWidgetType = "TEXT"
    ttTranslate.cWidgetName = ENTRY(iString, cStrings).
END.
```

4. Pass this to the API call, as shown:

```plaintext
RUN multiTranslation IN gshTranslationManager
  (INPUT NO, /* Not for all languages */
   INPUT-OUTPUT TABLE ttTranslate).
```

The same temp-table is returned with the `cTranslatedLabel` field filled with the translation. If the current language is the original language or if there is no translation for an item, then nothing is returned in the `cTranslatedLabel` field. Therefore you must check for this and use the original text string in that case, as shown:

```plaintext
/* If the current language is the original language or one for which there are no translations, then cTranslatedLabel is not set, so fall back on the original text. */
FOR EACH ttTranslate:
  IF ttTranslate.cTranslatedLabel = "" THEN
    ttTranslate.cTranslatedLabel = cWidgetName.
END.
```
5. Retrieve the appropriate temp-table record for each of the menu items and use the translation for the label. Note that they will not (likely) come back in the order in which you created them because there’s no sequence assigned (as in the example above), as shown:

```plaintext
FIND ttTranslate WHERE ttTranslate.cWidgetName = "Move Columns".
CREATE MENU-ITEM hColsMovableItem
  ASSIGN PARENT = hPopupMenu
  LABEL = ttTranslate.cTranslatedLabel /* "&Move Columns" */
  NAME = "ColsMovable"
  TOGGLE-BOX = TRUE
  CHECKED = FALSE.
```

6. After you are done using the temp-table, empty it, as shown:

```plaintext
EMPTY TEMP-TABLE ttTranslate.
```

7. Save and compile the modifications to browsercustom.p, delete the current running instance of the super procedure in the Procedures PRO*Tool, and return your test window. Now you see the translated strings, because you are logged in as a French user:

![Translated strings in French](image)

The Localization Manager itself uses translatePhrase and the other API calls here to translate titles, labels, and substitution arguments in messages. If you define text translations for these types of strings in your application, they will be translated for you in all the standard places where the framework handles translations. You can use the same calls as you did here to translate other text that the framework does not take care of for you.

---

**Using the Security Manager**

The Security Manager supports the tools under the Security menu in the Administration menu window, and applies security restrictions to an application based on the definitions you create in those tools. See the chapter on “Using the Toolbar and Menu Designer” in *OpenEdge Development: Progress Dynamics Basic Development* for more information on using tools.

This section briefly describes how you can use the manager’s API in your own application code.

The API includes calls to change a user’s password (changePassword), validate a user for a given login ID, password, and company (checkUser), and other useful calls that you can make from your own applications. In addition, there is a set of calls for the various types of security allocations that we described in *OpenEdge Development: Progress Dynamics Basic Development*: field-level, data-level, access-token, data-range, etc.
You can use these calls from any existing application to take advantage of both the login and user validation mechanism in the framework, and also to define security checks in existing application code based on the data structure and supporting tools in Progress Dynamics. You can also use these calls to make security checks in places where the framework does not automatically do it for you.

To see how this is done, you can add a security check to the browser custom super procedure you have been working on. This check allows the system administrator to disable the use and setting of browse profile settings on a per-user basis.

To add a security check:

1. Define a security token to represent the use of profiles and the browse pop-up menu, and then apply a restriction to a user based on that token.

2. Choose Security→Security Control. The Security Control window appears:


4. Click Add to define a new Action code.
5. Type **BrowsePopup** for the **Action code**, and give it an **Action description**: 

![Security Manager interface](image)

6. Save the new action. Choose the **Security Structure** tab just to remind yourself that, by default, a security token is defined for all **Product Modules**, all objects, and for any possible **Attribute code** that might be passed in to the object:

![Security Structure](image)
7. Choose **Security Control**→**Security Allocation**→**Actions** to create a restriction for a user.

8. Enter a user login name for the **Name** and click **Refresh**. If you completed the tutorial, you created a user login, **jacques**, that you can use here:

![Security Control Interface](image)

**Caution:** Do not alter the **admin** user doing experiments with security settings.

9. Select **BrowsePopup** in the **Available Actions** list and move it into the **User specific allocations**:

![Security Allocation Interface](image)
10. Click **Save**.

11. Exit the **Security Control** window.

12. Add code to the browser custom procedure to check for this code. The call you use is **tokenSecurityCheck**, as shown:

   ```
   RUN tokenSecurityCheck IN gshSecurityManager
     (INPUT  pcObjectName,
      INPUT  pcAttributeCode,
      OUTPUT pcSecurityOptions).  
   ```

   It takes these parameters:

   - **INPUT pcObjectName (CHARACTER)** — The current container name (with no path, if it’s a physical filename).
   - **INPUT pcAttributeCode (CHARACTER)** — The run-time attribute code, if any, passed in to the container.
   - **OUTPUT pcSecurityOptions (CHARACTER)** — A comma-separated list of security tokens for which the current user is restricted.

   In a case such as this one, where the token is defined for all objects, it would make sense to pass in a blank value for the `pcObjectName` parameter. However, the procedure will not return anything if you do this, so the application code uses the container name that is already available.

13. In `browsercustom.p`, go into the `initializeObject` procedure and define a variable called `cSecurityObjects`. The existing code already retrieves the `LogicalObjectName` of the browser’s container, so we can use that value for our call as well, as shown in the following example:

   ```
   /* Get the name of the container we're in, which is needed by both 
    * the tokenSecurityCheck and the profile data key. */
   {get ContainerSource hContainerSource}.
   IF VALID-HANDLE(hContainerSource) THEN
     {get LogicalObjectName cContainerName hContainerSource} NO-ERROR.
   ELSE
     cContainerName = "".
   ```

14. Add a call to `tokenSecurityCheck`, passing in the container name, and getting the token list back. Check for the `BrowsePopup` token in the list, and if it is there, just **RETURN**, as shown:

   ```
   /* Example of using the Security Manager. If the token BrowsePopup 
    * comes back for this user, then skip all the profile code. */
   RUN tokenSecurityCheck IN gshSecurityManager/
     (INPUT  cContainerName, /* pcObjectName */
      INPUT  "",           /* pcAttributeCode */
      OUTPUT cSecurityObjects).
   IF LOOKUP("BrowsePopup", cSecurityObjects) NE 0 THEN
     RETURN.
   ```
Note that the way this is coded, not only does the pop-up menu not get created, but any existing profile settings are not read out of the Repository, either. You could, of course, make this code work any way you want.

15. Save and compile this change, delete any current running instance of the browsercustom.p procedure, re-logon as the user you defined the restriction for, rerun your test window, and the pop-up menu should not be active. Also, any previously defined profile settings for the browse will not be applied.

Using the General Manager

As its name implies, the General Manager has API calls to support a number of different kinds of general-purpose requirements. These are summarized in the overview section at the beginning of this chapter.

Use the getEntityDescription procedure to retrieve a field value from any record of any table, given its key. This is a valuable way to get needed values from the Repository database without embedding hard-coded references to the Repository table structures into your code. It also handles the client/server division for you transparently. See OpenEdge Development: Progress Dynamics Managers API Reference for details on every call available in the General Manager.

There are other useful API calls provided by the General Manager. The first is getRecordDetail. Use this call to pass any query to the manager and get back a list of field names and values for the first record satisfying the query. The call is useful for queries that return just a single record, the equivalent of a unique FIND, as shown:

```
RUN getRecordDetail IN gshGenManager
   (INPUT pcQuery,
    OUTPUT pcFieldList ).
```

The procedure takes the following parameters:

- **INPUT pcQuery (CHARACTER)** — The query string, beginning with FOR EACH followed by the database table name.

- **OUTPUT pcFieldList (CHARACTER)** — A specially formatted list of field names and values for the matching record. What is returned is a CHR(3)-delimited list of `<table.field>` name and value pairs. In other words, each field name (qualified by the table name) is followed by CHR(3), followed by the field’s formatted string value, followed by another CHR(3), and so on. The record’s database ROWID is also returned, at the end of the list, in the format ROWID(<table> ) CHR(3) <table ROWID>. 
Here is a test procedure for `getRecordDetail`. It includes `globals.i`, so that the manager handle is available, defines a query to retrieve the first `Customer` record, and displays the results, as shown:

```alb
/* testRecordDetail.p -- test procedure for the getRecordDetail procedure in the General Manager API. */
{src/adm2/globals.i}
DEFINE VARIABLE pcQuery    AS CHARACTER NO-UNDO.
DEFINE VARIABLE cFieldList AS CHARACTER NO-UNDO.
DEFINE VARIABLE iField     AS INTEGER    NO-UNDO.

pcQuery = 'FOR EACH Customer where CustNum = 1'.

RUN getRecordDetail IN gshGenManager
  (INPUT pcQuery,
   OUTPUT cFieldList ).

DO iField = 1 TO NUM-ENTRIES(cFieldList, CHR(3)) BY 2:
  DISPLAY ENTRY(iField, cFieldList, CHR(3))     FORMAT "x(30)"
  ENTRY(iField + 1, cFieldList, CHR(3)) FORMAT "x(40)"
  WITH FRAME F 21 DOWN.
DOWN WITH FRAME F.
END.
```

Figure 6–8 shows what the procedure’s output looks like.

![Output of testRecordDetail.p](image)

Note the `ROWID` value at the end of the list. You can apply the ABL `TO-ROWID` function to this string to turn it back into a proper `RowID` data type.

As another example of how this call could be useful, consider the `translatePhrase` function described earlier. One of the parameters is the language object ID for the language to translate into. If what you want is the current language, you just pass in 0. But if you want some other language, you can use `getRecordDetail` to retrieve the `language_obj` field for the language if you know the Where clause to construct to retrieve the record you want. In this case:

```alb
FOR EACH gsc_language Where language_code = "French"
```
This query yields the results shown in Figure 6–9. The first field value is the language object ID, which you can convert to native DECIMAL form and pass in to another call that needs it.

Figure 6–9: FOR EACH query results

Keep in mind that because this is a general-purpose call, no caching of information is possible. Every query will result in an AppServer call in a distributed application. But also keep in mind that the call shields you from having to worry about the code needed to access the data on the AppServer, as long as the database you need is connected on the default AppServer whose handle is in gshAstraAppServer.

This series of examples should give you a good idea of how to take advantage of the Progress Dynamics managers to extend their default behavior to satisfy the needs of you application, and to help you integrate existing applications into a new Progress Dynamics application.
Creating a New Manager

A Progress Dynamics manager is a structured business logic procedure (or PLIP) that has both a client and a server part. The term manager here refers to a procedure with a few special characteristics:

- It operates on both sides of the AppServer connection and has both a client part and a server part.
- It is normally registered as part of the session type and is prestarted so that it is available to other procedures in the session when needed.
- It has an API that can be called from elsewhere in the application.

Beyond this, a manager can do just about anything at all.

The server side of the manager controls database access, and the client side coordinates access to the manager’s API. The client manager or client proxy cannot access database statements directly and acts as a gateway to calls that get information from the server. You can cache data on one or both sides of the AppServer connection, depending on the nature of the manager.

Progress Dynamics comes with a number of built-in managers. You can find more information on these managers in Chapter 6, “Using the Progress Dynamics Managers,” which briefly describes the architecture of the existing managers. The task of building a manager has been streamlined to make creating a new manager easier since the existing Version 1.1 managers were built, so the details of construction are different. This is why the description of the existing managers does not exactly match the use of the new manager template.
This chapter describes the new template procedures and how you can use them to create managers of your own for your application, as detailed in the following sections:

- The manager templates
- Building a new manager in the AppBuilder
- Registering your manager
- Creating a new Field Edit manager
- Customizing an existing manager
The manager templates

The Progress Dynamics manager has one basic characteristic that distinguishes it from other business logic procedures: it runs on both sides of the AppServer connection. In this way it shares one key characteristic of the SmartDataObject, which enables you to write code for it in the AppBuilder just as you do for SDOs or SDO logic procedures in a dynamic application. The template for new managers has the `DB-AWARE` flag set on to tell the AppBuilder to allow you to write code into this single procedure file and to designate whether that code should be compiled and executed for the client, for the server, or for both.

The `DB-AWARE` flag is, first of all, a preprocessor value in the template, as shown:

```plaintext
/* ********************  Preprocessor Definitions ******************** */
&Scoped-define PROCEDURE-TYPE Procedure
&Scoped-define DB-AWARE YES

/* *********************** Procedure Settings ************************ */
&ANALYZE-SUSPEND _PROCEDURE-SETTINGS
/* Settings for THIS-PROCEDURE */
  Type: Procedure
  Allow:
  Frames: 0
  Add Fields to: Neither
  Other Settings: CODE-ONLY APPSERVER DB-AWARE NO-PROXY
/*
&ANALYZE-RESUME _END-PROCEDURE-SETTINGS
```

You can also set the `DB-AWARE` flag in special `Procedure Settings` comments that the AppBuilder parses when it reads in a file for editing. The preprocessor allows your code to reference the `DB-AWARE` flag, and this internal setting prevents the value from being changed, which would disable the manager, as shown:

```plaintext
/* ********************  Preprocessor Definitions ******************** */
&Scoped-define PROCEDURE-TYPE Procedure
&Scoped-define DB-AWARE YES

/* *********************** Procedure Settings ************************ */
&ANALYZE-SUSPEND _PROCEDURE-SETTINGS
/* Settings for THIS-PROCEDURE */
  Type: Procedure
  Allow:
  Frames: 0
  Add Fields to: Neither
  Other Settings: CODE-ONLY APPSERVER DB-AWARE NO-PROXY
/*
&ANALYZE-RESUME _END-PROCEDURE-SETTINGS
```

In addition to the `DB-AWARE` setting, there is a setting for the AppBuilder’s information called `NO-PROXY`. This setting tells the AppBuilder that, unlike for an SDO, the AppBuilder should not actually generate the client proxy when you save the manager procedure.
There are several reasons for this:

- First, in the case of the SDO (or the similarly constructed SBO), the client proxy is always given a filename that is the same as the base procedure, but with the extension _cl. The external request runs the base procedure name, and the internal logic of the SDO (or, more precisely, the constructObject call in its container code) determines whether in fact it is that server-side procedure or the client proxy that should be run, depending on the session configuration. The client proxy is never run explicitly. This naming convention is not appropriate for managers, where either the client procedure or the server procedure is explicitly registered with the Session Type as the proper procedure to run when the session starts up. Therefore you can give the client procedure any name you want. For the sake of consistency, follow the existing Progress Dynamics convention of using a common prefix followed by srvrp.p for the server-side procedure and clntp.p for the client side, but there is no requirement that you follow this pattern.

- Second, all the parts of an SDO, including the base procedure (customerfullo.w, for example), its companion include file that defines the SDO temp-table, the client proxy procedure, and the logic procedure where you write validation logic, are considered a single unit in Progress Dynamics. Only the base procedure is registered in the Repository when you save the SDO. This is not the case for managers, because either the client or the server version of the manager is run for a given session type, and therefore both the client procedure and the server procedure must be individually registered.

- Third, if you do not want to save the client procedure to the same directory as the server procedure, the AppBuilder is not set up to save different procedures to different directories as part of a single operation. Progress Dynamics uses a convention of saving only procedures in the framework that will run on the AppServer in the app directory.

- Fourth, the client procedure normally never changes once it has been generated because it is really just two lines of code: one line sets a flag called DB-REQUIRED that tells the compiler to compile out database references, and a second line includes the server procedure. All the real code for both sides is in the server procedure; only the DB-REQUIRED flag tells the compiler which code to compile for which version.

So, for all these reasons, the AppBuilder does not generate or manage the client procedure for you. You can create the client procedure yourself by copying the template for it and naming the server filename that it should include.

The two template procedures that you use to build new managers are ry/app/rytemsrvrp.p and ry/obj/rytemclntp.p. The first is opened for you when you create a new manager in the AppBuilder, and the second you copy and edit yourself.

**Manager startup**

The standard startup procedure for any Progress Dynamics session is icfstart.p. This procedure runs the procedure af/app/afxmlcfgp.p, the Configuration File Manager, which opens and parses the XML configuration file containing all the rest of the information about the session. The Configuration File Manager starts the rest of the managers. In some cases it might not make a difference which order a manager is started in, except that the Connection Manager must always be first in the list, because it is responsible for starting any databases and AppServers, and then getting the rest of the managers started. Ordinarily you simply add a new manager to the end of the list, so make sure you note the number of managers that are already associated with your session type, and assign yours the next higher sequence number.
Customizing an existing manager

To customize an existing manager, create a new procedure and add the existing manager as a super procedure. The new procedure will consist of overrides and RUN SUPER statements.

Building a new manager in the AppBuilder

The process for making a new manager is simplified by using the wizard.

To create a new manager:

1. Click New.
2. Select Structured Manager in the New dialog box and click OK:

3. Step through the New Manager Wizard, setting the desired information to identify the procedure, and you are ready to code.
Separating client code from server code

Programming a manager is like programming any other business logic procedure, except that you write code for both sides of the server connection.

When you create a new procedure in the Section Editor, shown in Figure 7–1, you see a DB-Required toggle box in the header section that you can use to indicate whether the code you write goes into the client or server side when the procedure is compiled.

By default, the DB-Required toggle box is checked on. When it is on, the entire internal procedure or function you are writing compiles into only the server side .r file for the manager. If you turn it off, it goes into both the client and server files.

When you save your procedure, the AppBuilder writes these additional preprocessor definitions into your source procedure:

```
/* Db-Required definitions. */
&IF DEFINED(DB-REQUIRED) = 0 &THEN
  &GLOBAL-DEFINE DB-REQUIRED TRUE
&ENDIF
&GLOBAL-DEFINE DB-REQUIRED-START &IF {&DB-REQUIRED} &THEN
&GLOBAL-DEFINE DB-REQUIRED-END &ENDIF
```
The first of these definitions says that if the DB-REQUIRED preprocessor has not already been defined, then define it to be TRUE. The other two definitions provide for a wrapper around each entry point in the file. Around every function and internal procedure definition you create, the AppBuilder puts the DB-REQUIRED-START and DB-REQUIRED-END preprocessors that compile the entry point in or out, as shown:

```plaintext
{&DB-REQUIRED-START}
&IF DEFINED(EXCLUDE-testDBRequired) = 0 &THEN
&ANALYZE-SUSPEND _UIB-CODE-BLOCK _PROCEDURE testDBRequired Procedure _DB-REQUIRED
PROCEDURE testDBRequired :
/*----------------------------------*/
Purpose:
Parameters: <none>
Notes:
----------------------------------*/
END PROCEDURE.

jurestclntp.p - non-db proxy for jurestsrvrp.p */
&GLOBAL-DEFINE DB-REQUIRED FALSE
{"jurestsrvrp.p"}

This file sets the DB-REQUIRED flag to FALSE before the AppBuilder-generated statement in the main procedure has a chance to set it to TRUE. Therefore, all DB-REQUIRED blocks are left out of the compilation that winds up on the client.
Registering your manager

Once you have created your manager, you must register it so that it starts properly and is available for use at run time. First, you must register the procedure in the Progress Dynamics Repository, then create a Manager Type for it, and finally associate that type with one or more session types.

To register the manager procedure in the Repository:

1. Open the procedure in the AppBuilder, and choose **File → Save**:

   ![Save (Procedure) dialog](image)

   **Register object**

   **Object name**: myTestManager

   **Description**: 

   **Read directory**: ./OpenEdge/Appl/Session/objects/myTestManager

   **Product module**: .General//Objects used across sample

   **Full path name**: ./OpenEdge/Appl/Session/objects/myTestManager.obj

2. Select **Register object**.

3. Enter a **Product module** for the procedure.

4. Click **Save** to save this information in the Repository. Now you can refer to your procedure in the Session utilities.
Creating a new manager type

Each new manager must first have a type.

To create a new Manager Type:

1. Choose Session → Manager Type Control from the Administration window. The Manager Type Control appears:

2. Click Add to create a new control. The Manager Type Maintenance window appears:

The Manager Type Maintenance window has the following fields:

- **Manager type code** — A single-word identifier used as a key for retrieving the manager’s handle and to identify it to the Session Manager.

- **Manager type name** — Any meaningful descriptive string for the manager, which appears in messages referring to the manager. By convention, this is just the Manager type code with spaces, as appropriate.
• **Static handle** — The built-in Progress Dynamics managers have global variables defined for them in the file `src/adm2/globals.i`. Unless your new manager is going to be accessed with great frequency at different places within your application, which might possibly make it noticeably faster to have immediate access to the handle from anywhere, you should not add a new global handle for it. This would require you to edit `globals.i` and then recompile every procedure in the entire framework and in your application to provide access to it. The handles that are already in `globals.i` are there for efficiency for the basic framework managers (and not even all of those). Instead, you can use the `getManagerHandle` function in the Session Manager to retrieve the handle of your manager from anywhere in your application. In this case you set the Static Handle entry to **No Static Handle**.

• **System owned** — This toggle box restricts modifications to the manager to those users with System privilege.

• **Write to config** — If you want the manager information to be written out to the XML configuration file that holds all the session information, then check the **Write to config** toggle box on. If you want to associate the manager with one or more session types and have it automatically started for you when those sessions are started, then you must check **Write to config** on. If you intend to access the manager only programmatically once your application session has already started, then you can leave it off.

• **DB Bound Manager** — This field specifies the object to run for sessions that have a database connection (that is, for a session that has a service type of database connection as one of the session services). This manager requires a database connection and communicates directly with schema tables.

• **DB Unbound Manager** — This field specifies the object to run for sessions that do **not** have a database connection (that is, for a session that does not have a service type of database connection as one of the session services). This manager does not require a database connection and communicates indirectly with schema tables through the bound manager object running server side in a session with a database connection.

• **Manager narration** — This field is for any explanation of the manager’s purpose.

3. Enter the information for your new manager and click **Save**. You return to the **Manager Type Control** window and see the new manager in the manager list:
Adding your manager to the session types

Start your manager with one of the framework’s session types by adding to the list of that Session Type’s Required Managers.

To add your manager to the list of that Session Type’s Required Managers:

1. Open the Session Type Maintenance window from the Session menu:

   ![Session Type Maintenance Window]

   The session types are set up in hierarchies, inheriting properties from their parents.

2. Choose SessionType→ Basic→ Dynamics→ DynDBBound→ DynCS→ Default→ Required Managers.
3. Right-click and choose **Add required manager** from the pop-up menu.

4. Select **Test manager** in the **Manager type** combo-box:

![Image of Session Type Maintenance with Test manager selected in Manager type combo-box]

5. Set the **Startup order** to the next available one.

6. Check the **System owned** toggle box on if you want only users with System authorization to be able to modify its information.

7. Click **Save** to add your manager to the **Default** session type:

![Image of Session Type Maintenance with Test manager added in Default session type]
Registering your manager

Your manager is now in the Repository’s description of the Default session type. But, in order for it to be found when the session starts up, the same information has to be in XML configuration file that all sessions read at startup.

8. Choose **Option→Generate Configuration File** to rebuild the XML file from the Repository data. The **Generate Configuration File** dialog box appears:

![Generate Configuration File dialog box](image)

9. Enter the name of the configuration file, and select either **Local File** or **Remote File**, depending on whether the file is local to your machine or remote.

**Note:** The default file is `OpenEdge_install_dir\src\dynamics\icfconfig.xml`. You should avoid overwriting that default file for this exercise.

10. Select the session types that you want in your custom configuration file from the Available Session Types list and add them to the Selected Session Types List. You can use this functionality to tailor the configuration file for particular deployments:

![Selected Session Types](image)
11. Click **Generate Config File**. A message dialog appears to confirm the successful completion of the file.

12. Open the new configuration file in a Web browser and find the node for your new manager:

![XML configuration file]

This file contains the information for the **Test Manager** added to the **Default** session (a number of nodes in the XML information are not expanded here, so that you only see what has been added).

**Invoking the session type in your startup command**

To start the **Session Type** with your manager in it, specify the **Session Type** in the startup command line. The startup procedure is `icfstart.p`, and the `-ictparam` startup option must specify the `ICFSESSTYPE` parameter and give it a value of `Default`, or whatever your **Session Type** is. Then when you open the session, your manager is started along with the others.
In this simple test case, the standard `plipSetup` procedure in the Test Manager has a MESSAGE in it to show you that it got started properly:

```plaintext
Procedure plipSetup:
/*-----------------------------------------------
   Purpose: Run by main-block of PLIP at startup of PLIP
   Parameters: <none>
   Notes: -----------------------------------------------*/
{ry/app/ryplipsetu.i}
MESSAGE "Test Manager!".
END PROCEDURE.
```

When you start the Default session, the following message appears:

![Message](image)

Creating a new Field Edit manager

This section contains an example of how to design, build, and register a new Field Edit Manager.

The Field Edit Manager supports the definition of special kinds of editing and validation for fields in the application’s database. It also supports the visualization of these characteristics in the client user interface. For example, the developer can define fields that are mandatory, independent of the OpenEdge schema definitions, provide a visual cue for those mandatory fields in the viewers in the application’s maintenance windows, and then ensure that those fields have all been entered before an update is returned to the server. You can define a field as requiring uppercase or lowercase letters only, and you can adjust the screen value for the field accordingly before updated values are returned to the server. This example illustrates a number of ways in which you can extend the framework, including:

- Adding a new table to the Repository.
- Defining the manager itself.
- Registering the new manager.
- Accessing the manager from SDOs.
- Accessing the manager from viewers.
- Invoking the field edits from an SDO.
- Testing the new manager.
Creating a New Manager

Adding a new table to the Repository

If your application requires data that cannot easily be represented in the Repository database tables, you can add an additional table or tables to store it. Whether you actually add these tables to the Repository database itself (ICFDB) or to your application database is up to you. In either case, you can join the new tables to other Repository tables to provide a connection between standard Repository data and your extensions.

In this case, you need a new table to store the field edit definitions for the manager to use. This is an extension to the Repository definition of entities (tables) and their fields. When you import entity definitions into the Repository as the first step in defining a Progress Dynamics application for your database, the framework creates an Entity Mnemonic record for each table, and an entity display field record for each field in the table, with some of its display characteristics, such as its label and format. The Object Generator uses this data to create the default SDOs, browsers, and viewers that make up the starter set of objects in the application.

Figure 7–2 shows these two standard Repository tables.

![Standard Repository tables](image)

To support the Field Edit Manager, you must add an additional table to store field edit information for each field. The table is called gsc_entity_field_edit. You can create it in the OpenEdge Data Dictionary. The table contains the fields described in Table 7–1.

Table 7–1: The gsc_entity_field_edit table

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>entity_field_edit_obj</td>
<td>This DECIMAL field is the object ID for the record itself.</td>
</tr>
<tr>
<td>entity_display_field_obj</td>
<td>This DECIMAL field is the object ID of the associated gsc_entity_display_field record to join to.</td>
</tr>
<tr>
<td>edit_type</td>
<td>This CHARACTER field stores the code for the special edit type, such as Required or Case.</td>
</tr>
<tr>
<td>edit_value</td>
<td>This CHARACTER field stores the value for the edit type, such as Yes for Required, or Upper or Lower for Case.</td>
</tr>
</tbody>
</table>
You must have a unique primary index on the `entity_field_edit_obj` field, and a second index on this field plus the `edit_type` field.

When creating the new table, provide the appropriate format for the object ID fields, with nine decimals to assure that the site ID for the database is properly encoded, as shown in Figure 7–3.

![Field Properties window](image)

**Figure 7–3:** Field Properties window

Use a CREATE trigger procedure to define code that assigns the next available object ID to each new record. The procedure must include the standard framework code that defines the `getNextObj` function and invoke it to assign the ID. The Table Triggers dialog box is shown in Figure 7–4.

![Table Triggers dialog box](image)

**Figure 7–4:** Table Triggers dialog box
How does the field edit data gets into the new table? Presumably, you create a tool where developers define special edits, but that is beyond the scope of this discussion. You can populate the table using a procedure to define some test values, such as the following example, which marks the CustNum, Name, City, State, and Country fields in the Sports2000 database Customer table as required fields, and the State field as requiring uppercase. For example:

```sql
FOR EACH gsc_entity_display_field WHERE entity_mnemonic = 'customer':
    IF LOOKUP(display_field_name, 'custnum,name,city,state,country') NE 0 THEN
        DO:
            CREATE gsc_entity_field_edit.
            ASSIGN gsc_entity_field_edit.entity_display_field_obj =
                gsc_entity_display_field.entity_display_field_obj
            gsc_entity_field_edit.edit_type = "Required"
            gsc_entity_field_edit.edit_value = "YES".
        END.
    END.
    IF display_field_name = 'State' THEN
        DO:
            CREATE gsc_entity_field_edit.
            ASSIGN gsc_entity_field_edit.entity_display_field_obj =
                gsc_entity_display_field.entity_display_field_obj
            gsc_entity_field_edit.edit_type = "Case"
            gsc_entity_field_edit.edit_value = "Upper".
        END.
END.
```

**Defining the manager itself**

In the AppBuilder, choose New→ Structured Manager to create the new manager procedure from its template. Enter the standard file documentation information in the wizard. Name the procedure `fldedsrvrp.p`. Note that this server-side manager procedure in fact contains all the code for both the client and server versions of the manager. As you write code for the manager, the DB-REQUIRED flag determines which code gets compiled into which version of the manager.

To create the client-side manager procedure, simply copy the client manager template, which is the file `af/sup2/aftemclntp.p`, to the working directory where you want your manager. Name your version `fldedclntp.p`. Edit the file to include the server manager procedure `fldedsrvrp.p`, including its relative pathname, depending on your own directory structure, as shown:

```sql
/* fldedclntp.p - non-db proxy for fldedsrvrp.p */
&GLOBAL-DEFINE DB-REQUIRED FALSE
{"fldedsrvrp.p"}
```

As you can see, the client procedure simply defines the DB-REQUIRED flag to be false and then includes the principal (server) manager procedure. In this way, the references to DB-REQUIRED inside `fldedsrvrp.p` determine which code gets compiled out of the client procedure. Save the client manager procedure and compile it when you have finished writing the manager. All your code now goes into `fldedsrvrp.p`. 
Data caching considerations

The first procedure to define in the manager, `cacheFieldEdits`, builds a client-side cache of data from the `Entity Field Edit` table.

Different kinds of managers might need to cache different data on either the client or server or both. Keep the following things in mind when you’re designing the caching mechanism for a manager:

- If code that is executed on the server needs quick access to data, it might be worthwhile to cache that data in temp-tables on the server side. This is especially true if the data must be massaged in some way as it is read out of whatever underlying database tables or other data sources provide the raw information, and if that data processing is relatively expensive. Caching the data once it has been read and processed makes it available for later access without incurring that overhead again.

- If there is a benefit to avoiding the caching overhead when a request comes in from a client, then the server start-up code might want to cache data in advance. Whether this is all the data derived from the underlying database tables (or any other source) or some part of the data is up to you to decide. You must balance the up-front startup cost of caching the data against the immediate cost of caching the data when the first request comes in that needs that particular data. If the server-side manager is prestarted as part of an AppServer session, which will be the case if the manager is made one of the required managers in the session type, then this startup cost might occur when the overall system is started, and the AppServer sessions might continue to run for a long time. In this case, an end user starting a client session or making a request from a client might never see the overhead of the server caching, making the precaching an appropriate action.

- If code that is executed on the client needs access to data that originates in database tables, the data must be passed from the server to the client so that the client does not need a database connection. If the data is likely to be needed again on the client, it makes sense to cache it in temp-tables there so that it’s available when needed.

- There might be a benefit on the client as well as the server to precaching data. Because the user will normally experience a wait when starting the application due to the overhead of precaching data, you must balance the benefit of having the data immediately available later on against the cost of loading it on startup.

- If data cached on either the client side or the server side might become stale or out-of-date, you must provide a way to determine when that data must be refreshed, and a mechanism to clear the old data from the client cache so that it is re-retrieved from the server, or to clear old data from the server cache so that it can be reloaded from the database.

- In a stateless environment, any server-side temp-table cache is local to a particular AppServer session, and if the data isn’t precached in a uniform way, the data in any AppServer session is simply a by-product of the client requests that happen to come in to that session. Since a client request can be handled by any available AppServer session, you can’t expect that data cached by some earlier request is in the cache of the server session that handles the next request. If server-side data is not precached, but it makes sense to cache data on the server at all, then you must simply allow for the fact that each AppServer session gradually builds up a cache reflecting the requests that it has handled. Thus, if precaching is not appropriate, you can still gain the efficiencies of a cache as the server sessions gradually build up data from the requests they handle.
In the case of the example Field Edit Manager, data caching makes sense only on the client. Each time an SDO starts up, it requests the field edit data for its enabled table or tables from the Field Edit Manager. If that data isn’t already available, then the client manager requests it from the server manager and adds it to the client cache.

The cache temp-table has the following definition:

```plaintext
DEFINE TEMP-TABLE ttFieldEditData NO-UNDO
  FIELD cEntityName       AS CHARACTER
  FIELD cFieldName        AS CHARACTER
  FIELD cEditType         AS CHARACTER
  FIELD cEditValue        AS CHARACTER
  INDEX key1 AS UNIQUE PRIMARY cEntityName cFieldName cEditType.
```

The Entity Name comes from the Entity Mnemonic table, and the Field name from the Display Field table. The Edit Type and Edit Value come from the new Field Edit table.

The `cacheFieldEdits` procedure takes a list of one or more tables as input, and checks to see whether the field edit data for the tables is already in the cache temp-table. Note that because the procedure will normally be called on the client, the section editor's DB-Required toggle box must be checked off so that the code is compiled into the client version of the manager, as shown in Figure 7–5.

```plaintext
DEFINE TEMP-TABLE ttFieldEditData NO-UNDO.
FIELD cEntityName       AS CHARACTER.
FIELD cFieldName        AS CHARACTER.
FIELD cEditType         AS CHARACTER.
FIELD cEditValue        AS CHARACTER.
INDEX key1 AS UNIQUE PRIMARY cEntityName cFieldName cEditType.
```

Figure 7–5: Section Editor
Creating a new Field Edit manager

If any of the tables are not yet cached, then the code calls a separate procedure that has the DB-Required flag set to TRUE to load them from the Repository database. The cacheFieldEdits procedure must check whether the procedure that reads the database is available to run locally or must be run remotely, so that it knows where to run the database-dependent code. Because the DB-Required procedure is completely compiled out of the client manager when the manager is split between client and server, the code can check for the existence of the DB-Required procedure in the manager’s internal entries. If it is not there, then it must be run remotely. This code fragment uses the include file dynlaunch.i to make the call, which is explained in the following example:

```abl
IF cTablesToRead NE ':U THEN DO:
    IF LOOKUP('fetchFieldEdits', THIS-PROCEDURE:INTERNAL-ENTRIES) NE 0 THEN
        RUN fetchFieldEdits (INPUT pcTableList,
                            OUTPUT TABLE ttNewData).
    ELSE {dynlaunch.i
        &PLIP = 'FieldEditManager'
        &iProc  = 'fetchFieldEdits'
        &mode1  = INPUT &parm1 = pcTableList &dataType1 = CHARACTER
        &mode2  = OUTPUT &parm2 = ttNewData &dataType2 = TABLE
    }

IF CONNECTED('ICFDB') THEN
```

An alternative way to make this check is to use the following statement:

```abl
IF CONNECTED('ICFDB') THEN
```

This has the disadvantage of hard-coding the logical database name where the data resides into the procedure, which might not be a good idea. If you later move the data (to your application database, for example) then you must remember to change this statement as well.

**Using dynlaunch.i to make server calls in your manager**

The include file dynlaunch.i supports making a call to an internal procedure inside a server-side procedure, which might or might not already be running. It uses the ABL dynamic Call object to package the parameters to the procedure call. It handles all these steps in a single AppServer call:

- Identifying whether the external procedure is already running on the server, and starting it as a persistent procedure if it isn’t.
- Running the internal procedure inside the server-side persistent procedure.
- Getting back the OUTPUT parameters from the internal procedure call.
- Deleting the server-side procedure if it was started just for this call.

As a result, using dynlaunch.i is generally the preferred way to make calls to internal procedures across the AppServer connection in Progress Dynamics Version 2, as long as the external procedure on the server does need to be started and then left running after the call is complete.
These are the basic include file arguments for `dynlaunch.i`:

- The include file takes an `&PLIP` named argument that is the name of the external procedure needed on the server. Alternatively, as in this example, it can be the logical name (the Manager Type name) of any registered Progress Dynamics manager, including a newly created one such as this.

- The `&Iproc` named argument is the name of the internal procedure to run.

There must be three named arguments for each parameter in the internal procedure’s calling sequence. For each of these, the letter `n` represents the order of the parameters in the call:

- The `&mode` named argument is `INPUT`, `OUTPUT`, or `INPUT-OUTPUT`.

- The `&parm` named argument is the name of the variable or table field storing the parameter.

- The `&datatype` named argument holds the data type of the parameter.

As with all include file references, quoted strings must be inside single quotes. If a string argument includes spaces or other word breaks, then the single-quoted string must then be inside double quotes.

In the case of this example, the code is running the internal procedure `fetchFieldEdits` in the server-side `FieldEditManager`, and passing as an `INPUT` parameter a list of the tables to retrieve edit information for, and returning as an `OUTPUT` parameter a temp-table containing those edits.

**Writing the server-side caching procedure**

The procedure that reads database data into the temp-table is separate from `cacheFieldEdits` because it must have the `Db-Required` toggle box set to `TRUE`, so that it will be compiled only on the server-side, or when the database is otherwise available.

This `fetchFieldEdits` procedure uses a copy of the `ttFieldEditData` temp-table that must also be defined in the **Definitions** section of the manager, as shown below:

```plaintext
DEFINE TEMP-TABLE ttNewData NO-UNDO LIKE ttFieldEditData.
```
Creating a new Field Edit manager

This is so that only the data for the current request is returned in the call. The client-side cache will gradually be built up as more requests are made. Because no data is maintained in memory on the server, fetchFieldEdits first needs to empty out any leftover data from an earlier request. For example:

```
Procedure fetchFieldEdits:
/*-------------------------------------------------------------------------
Purpose:     Server-side procedure to load field edit data from the database into a temp-table, to be returned to the client.
Parameters:  INPUT PARAMETER pcTableList AS CHARACTER NO-UNDO -- list of tables to cache.
             OUTPUT PARAMETER TABLE FOR ttNewData -- returned temp-table.
Notes:       This DB-REQUIRED procedure is executed on the server, from the client, if the Manager is divided between client and server.
             It only loads newly requested data into the NewData temp-table, and returns that to be appended to the client cache.
-------------------------------------------------------------------------*/
DEFINE INPUT  PARAMETER pcTableList AS CHARACTER  NO-UNDO.
DEFINE OUTPUT PARAMETER TABLE FOR ttNewData.
DEFINE VARIABLE iNum AS INTEGER    NO-UNDO.
/* Remove any leftover data from a previous request. The ttNewData table just holds the data for the current request and returns that to the client. */
EMPTY TEMP-TABLE ttNewData.

The procedure then goes through the list of requested tables, locates any FieldEdit records for their fields, and creates temp-table records for them, as shown:

```
/* Read field edit data from database into the temp-table to return to the caller. */
DO iNum = 1 TO NUM-ENTRIES(pcTableList):
    FIND FIRST gsc_entity_mmemonic WHERE
        gsc_entity_mmemonic.entity_mmemonic_description = ENTRY(iNum, pcTableList) NO-LOCK NO-ERROR.
    IF AVAILABLE gsc_entity_mmemonic THEN DO:
        FOR EACH gsc_entity_display_field OF gsc_entity_mmemonic,
            EACH gsc_entity_field_edit OF gsc_entity_display_field NO-LOCK:

            CREATE ttNewData.
            ASSIGN
                ttNewData.cEntityName =
                    gsc_entity_mmemonic.entity_mmemonic_description
                ttNewData.cFieldName =
                    gsc_entity_display_field.DISPLAY_field_name
                ttNewData.cEditType =
                    gsc_entity_field_edit.edit_type
                ttNewData.cEditValue =
                    gsc_entity_field_edit.edit_value.
        END. /* for each entity field edit of each display field */
    END. /* if available entity */
END. /* do to number of tables */

RETURN.
END PROCEDURE.
```
Back in the calling procedure, `cacheFieldEdits`, this data is copied into the client cache, as shown:

```plaintext
FOR EACH ttNewData:
    CREATE ttFieldEditData.
    BUFFER-COPY ttNewData TO ttFieldEditData.
END.
```

Note that it would be slightly more efficient to use the `APPEND` keyword with the `OUTPUT` parameter and have the new data added directly to the existing client cache. However, the underlying mechanism that supports `dynlaunch` does not allow this, so this is a penalty paid when using it. Keep in mind that in more complex caching examples, it is likely that there would be some overlap between data returned and data already on the client that couldn’t be checked in advance. For example, if you were to use the Repository Manager API to retrieve object definitions to cache on the client, then even when the parent object was uniquely identifiable, a single request could return a whole host of data for various object instances contained in that parent object, some of which might already be present in the client cache.

In such a case you would have to receive new data in a separate table or set of tables anyway, and then do the necessary work on the client side to determine whether any of the data was already present, to avoid potential clashes of unique object IDs or other keys.

### Clearing the client cache

In order to clear the cache on the client side if it must be refreshed, you can define a `clearClientCache` procedure. This checks whether it is being invoked on the server or not, and empties the temp-table if it is on the client. The `DB-Required` toggle box must be checked off for this procedure, as shown:

```plaintext
 Procedure clearClientCache:
  /*-------------------------------------------------------------------------
  Purpose:     This procedure clears the cache of field edit data.
  Parameters:  <none>
  Notes:       
  *-------------------------------------------------------------------------*/

  IF NOT (SESSION:REMOTE OR SESSION:CLIENT-TYPE = "WEBSPEED":U) THEN DO:
    EMPTY TEMP-TABLE ttFieldEditData.
  END.

 END PROCEDURE .

```

In this way, any further requests of the cache on the client side will force a request to the server, since no cached data will be found on the client.
Creating a new Field Edit manager

Note the use of the syntax, as shown:

```sql
IF [NOT] (SESSION:REMOTE OR SESSION:CLIENT-TYPE = "WEBSPEED") THEN...
```

This expression tells the code whether it is executing on the server-side of a connection that has a separate client. Only if this is not the case do you want to empty the cache temp-table, because it is not maintained on the server.

**Note:** In this example, you could safely empty the temp-table on the server as well, because nothing is maintained there anyway. However, in cases where data is cached separately on client and server, it could make a big difference which side you empty the cache on.

The NOT keyword is included in the statement to make it TRUE for the client side (including a stand-alone client with a local database connection) or omitted to make it TRUE for the server side. The SESSION:REMOTE attribute is true if this is an AppServer session. Otherwise, the CLIENT-TYPE attribute will be equal to WEBSPEED if the session is a WebSpeed Agent. In either of these cases, the code is executing remotely relative to the user interface and presumes to have a database connection to the Repository data.

Note that this expression is a little different in its effect from the earlier check of the INTERNAL-ENTRIES, or for that matter making a CONNECTED database check. In the case where the client and server are effectively combined, that is, when the client session is running the full server-side manager with a database connection, none of the INTERNAL-ENTRIES or CONNECTED checks will return TRUE because the full manager is running and the database is connected. But the NOT SESSION:REMOTE check will also return TRUE because it is a not a remote session. This is as it should be, since a single session is doing the work of both client and server. Think about which of these types of checks you want to use in a particular situation, depending on the logic of the code being bracketed by the expression.

**Retrieving field edit data on the client**

Now that you’ve taken care of getting field edit data cached on the client, you need a procedure to do lookups in it for client-side objects that need the information. You can do this with a procedure called `getFieldEditData`. This takes input parameters for the table, field, and one or more types of edit types the caller needs values for, and returns a delimited list of the values. On the chance that the value for some new Edit Type might itself contain a comma, the Edit Values OUTPUT parameter uses CHR(3) as a delimiter between the values for the requested edit types.

The procedure simply looks up the requested records in the temp-table and returns their values, returning blank for edit types not defined for the fields in the temp-table. Note that the code presumes that the data is already available in the client cache, because the SDO for the table will have requested it. If this isn’t reliably the case (perhaps because `clearClientCache` might have been called after the SDO was initialized), this procedure could run `cacheFieldEdits` itself if the data needed isn’t available.
Creating a New Manager

Remember to check the **DB-Required** toggle box off for this procedure:

```
Procedure fieldEditData:
/*-------------------------------------------------------------------------
Purpose: Returns field edit data for a database field. It can return edit values for one or more edit types.
Parameters: INPUT pcTable AS CHARACTER - Table name
            INPUT pcField AS CHARACTER - Field name
            INPUT pcEdittypes AS CHARACTER - Edit types can be a comma-delimited list
            OUTPUT pcEditValues AS CHARACTER - Edit Values will be a CHR(3)-delimited list for multiple edit types
Notes:
------------------------------------------------------------------------*/
DEFINE INPUT PARAMETER pcTable AS CHARACTER NO-UNDO.
DEFINE INPUT PARAMETER pcField AS CHARACTER NO-UNDO.
DEFINE INPUT PARAMETER pcEdittypes AS CHARACTER NO-UNDO.
DEFINE OUTPUT PARAMETER pcEditValues AS CHARACTER NO-UNDO.
DEFINE VARIABLE itypes AS INTEGER NO-UNDO.
DO itypes = 1 TO NUM-ENTRIES(pcEdittypes):
   FIND ttFieldEditData WHERE
      ttFieldEditData.cEntityName = pcTable AND
      ttFieldEditData.cFieldName  = pcField AND
      ttFieldEditData.cEditType   = ENTRY(itypes, pcEdittypes) NO-LOCK NO-ERROR.
   pcEditValues = pcEditValues +
      (IF itypes > 1 THEN CHR(3) ELSE '':U) +
      IF AVAILABLE ttFieldEditData THEN
         ttFieldEditData.cEditValue ELSE '':U.
   END. /* DO 1 to number of edit type entries */
END.
RETURN.
END PROCEDURE.
```

**Registering the new manager**

Now that you have completed the manager procedure, you must make it available to the Session types that need it. Remember that you have both a client version and a server version. The server version, f1dedsrvrp.p, must be specified for any session that expects to have the Repository database connected. This would include both server-side AppServer session types and stand-alone client-server session types. The client version of the procedure, f1dedclntp.p, should be added to a client **Session Type** that will not have the database connected.

To register the Field Edit Manager, follow the procedure described in the “Registering your manager” section on page 7–8. Give it a **Manager Type Code** of FieldEditManager.
Creating a new Field Edit manager

Accessing the manager from SDOs

When an SDO is initialized, it requests the field edit data for its enabled tables. To define the code to support this, you can create a custom override procedure for the data class. As with other custom super procedures used to subclass an object, edit the src/adm2/custom/datacustom.i procedure to uncomment the line that starts the super procedure adm2/custom/datacustom.p. Then create a local src/adm2/custom/datacustom.p procedure and edit it to add a local version of initializeObject. For example:

```
Procedure initializeObject:
/*----------------------------------------------
   Purpose:     Override of initializeObject procedure.
   Parameters:  <none>
   Notes:       This gets the handle of the Field Edit Manager and passes it a list of enabled tables in this SDO to cache field edits for.
-----------------------------------------------*/
DEFINE VARIABLE cEnabledTables    AS CHARACTER  NO-UNDO.
DEFINE VARIABLE hFieldEditManager AS HANDLE     NO-UNDO.
RUN SUPER.
   hFieldEditManager = DYNAMIC-FUNCTION('getManagerHandle':U IN gshSessionManager,
                                           INPUT 'FieldEditManager':U).
   cEnabledTables = DYNAMIC-FUNCTION('getEnabledTables':U IN TARGET-PROCEDURE).
   RUN cacheFieldEdits IN hFieldEditManager (INPUT cEnabledTables).
END PROCEDURE.
```

The procedure first gets the handle of the new manager from the Session Manager, using the Session Manager's global handle, gshSessionManager, and the logical name FieldEditManager. Then it gets the list of enabled tables from the SDO itself and runs the cacheFieldEdits procedure in the manager.
Creating a New Manager

Next, the SDO needs a procedure to do validations against the rules defined in the field edits. If any errors in the detail are detected, this `fieldEditValidate` procedure creates a message string in the format expected by the standard validation support, as shown:

```plaintext
Procedure fieldEditValidate:
/*-------------------------------------------------------------------------
Purpose:     Perform validation stored in the entity field edit table.
Parameters:  OUTPUT pcMessageList AS CHARACTER
Notes:       Invoked by SDO data logic procedure RowObjectValidate, if any
errors occurs, they should be passed back to RowObjectValidate.
-------------------------------------------------------------------------*/
DEFINE OUTPUT PARAMETER pcMessageList  AS CHARACTER  NO-UNDO.
DEFINE VARIABLE cEditValues        AS CHARACTER  NO-UNDO.
DEFINE VARIABLE cEnabledTables     AS CHARACTER  NO-UNDO.
DEFINE VARIABLE cTable             AS CHARACTER  NO-UNDO.
DEFINE VARIABLE cValueList         AS CHARACTER  NO-UNDO.
DEFINE VARIABLE hColumn            AS HANDLE     NO-UNDO.
DEFINE VARIABLE hFieldEditManager  AS HANDLE     NO-UNDO.
DEFINE VARIABLE hLogicBuffer       AS HANDLE     NO-UNDO.
DEFINE VARIABLE iCol               AS INTEGER    NO-UNDO.
DEFINE VARIABLE iNumTables         AS INTEGER    NO-UNDO.

hFieldEditManager= DYNAMIC-FUNCTION('getManagerHandle':U IN
gshSessionManager, 
            INPUT 'FieldEditManager':U).

After retrieving the manager handle, the procedure retrieves the `LogicBuffer` handle from the SDO. The `LogicBuffer` is in fact defined in the logic procedure of the SDO, and is the buffer for the record as it is accessed by the validation entry points in the logic procedure, such as `rowObjectValidate`, as shown:

```plaintext
RUN getLogicBuffer IN TARGET-PROCEDURE (OUTPUT hLogicBuffer).
```

For each column in the buffer, the code asks the Field Edit Manager whether there is a Required edit type or a Case edit type defined for that field, by running `getFieldEditData`, as shown:

```plaintext
DO iCol = 1 TO hLogicBuffer:NUM-FIELDS:
    hColumn = hLogicBuffer:BUFFER-FIELD(iCol)
    cTable = DYNAMIC-FUNCTION('columnTable':U IN TARGET-PROCEDURE, 
                              INPUT hColumn:NAME).
    IF VALID-HANDLE(hFieldEditManager) THEN
        DO:
            RUN getFieldEditData IN hFieldEditManager
                (INPUT cTable, 
                 INPUT hColumn:NAME, 
                 INPUT 'Required,Case':U, 
                 OUTPUT cEditValues).
```

**Note:** This is not a particularly efficient way to determine which fields are required, since it involves making a separate call to the manager for every field in the SDO's buffer, even though most of these probably do not have a record in the temp-table cache. If you are designing a new manager, you should consider the most efficient way to get the information you need and structure the data and the calls accordingly.
If there is a Required type, and its value is Yes (which is normally the case if it is defined at all), and the STRING-VALUE of the field is blank, then the code uses the framework’s aferrortxt.i include file to format a message using the built-in message with the key AF1, as shown:

```plaintext
/* Check the Required edit first. */
IF ENTRY(1,cEditValues,CHR(3)) = 'Yes':U AND
   hColumn:STRING-VALUE = '':U THEN
   ASSIGN pcMessageList = pcMessageList +
   (IF NUM-ENTRIES (pcMessageList,CHR(3)) > 0 THEN CHR(3) ELSE ''':U) +
   {aferrortxt.i 'AF' '1' cTable hColumn:NAME hColumn:LABEL}.
```

If you look up this message in the Administration System menu, under Message Control, you see the display shown in Figure 7–6.

![Message Control window](image)

**Figure 7–6: Message Control window**

The hColumn:LABEL argument to aferrortxt.i is the value used for the substitution argument &1 in the Error Summary Description.

Next, the code checks the other type of edit, which specifies that a character field should be uppercase or lowercase, and makes the appropriate change, as shown:

```plaintext
/* Then check the Case edit, and adjust the value of the field if there's an edit defined for it. */
CASE ENTRY(2,cEditValues,CHR(3)):
   WHEN 'Upper':U THEN
      ASSIGN hColumn:BUFFER-VALUE = CAPS(hColumn:BUFFER-VALUE).
   WHEN 'Lower':U THEN
      ASSIGN hColumn:BUFFER-VALUE = LC(hColumn:BUFFER-VALUE).
   OTHERWISE.
      END CASE.
   END. /* if valid field edit manager handle */
END. /* do to number of fields in logic buffer */
END PROCEDURE.
```
Accessing the manager from viewers

In order for viewers to display a visual cue for required fields, you must override the standard viewer behavior with a customviewer.p procedure. As for the data class, edit src/adm2/custom/customviewer.i to start the super procedure adm2/custom/viewercustom.p. Then create a local version of src/adm2/custom/viewercustom.p and define an enableFields procedure in it. Invoke the standard behavior with a RUN SUPER statement, and then retrieve the Field Edit Manager handle, as shown:

```plaintext
Procedure enableFields:
/*------------------------------------------------------------------------------------------
 Purpose: Override of enableFields to apply affordance for field edits defined in the entity field edit table.
 Parameters: <none>
 Notes: --------------------------------------------------------------------------------------------*/
DEFINE VARIABLE cEditValue        AS CHARACTER  NO-UNDO.
DEFINE VARIABLE cFieldHandles     AS CHARACTER  NO-UNDO.
DEFINE VARIABLE cTable            AS CHARACTER  NO-UNDO.
DEFINE VARIABLE hDataSource       AS HANDLE     NO-UNDO.
DEFINE VARIABLE hField            AS HANDLE     NO-UNDO.
DEFINE VARIABLE hFieldEditManager AS HANDLE     NO-UNDO.
DEFINE VARIABLE hSideLabel        AS HANDLE     NO-UNDO.
DEFINE VARIABLE iNumField         AS INTEGER    NO-UNDO.
RUN SUPER.

hFieldEditManager= DYNAMIC-FUNCTION('getManagerHandle':U IN gshSessionManager,
                                    INPUT 'FieldEditManager':U).
```

Now you must get the DataSource handle (the viewer’s SDO), which you use to identify the columnTable property for each of the viewer’s fields. This is the database table the column is derived from, and becomes one of the arguments to getFieldEditData.

You also must retrieve the FieldHandles property of the viewer. This is a list of the widget handles for the field representations in the viewer.

For each of the fields, run getFieldEditData in the manager to see if there is a Required edit for the field, as shown:

```plaintext
hDataSource = DYNAMIC-FUNCTION('getDataSource':U IN TARGET-PROCEDURE).
cFieldHandles = DYNAMIC-FUNCTION('getFieldHandles':U IN TARGET-PROCEDURE).

DO iNumField = 1 TO NUM-ENTRIES(cFieldHandles):
    hField = WIDGET-HANDLE(ENTRY(iNumField, cFieldHandles)).

    cTable = DYNAMIC-FUNCTION('columnTable':U IN hDataSource,
                               INPUT hField:NAME).

    IF VALID-HANDLE(hFieldEditManager) THEN
        DO:
            RUN getFieldEditData IN hFieldEditManager
            (INPUT cTable,
             INPUT hField:NAME,
             INPUT 'Required':U,
             OUTPUT cEditValue).
```
If there is a Required edit, then you modify the side label for the field to begin with an asterisk, as shown:

```asm
IF cEditValue = 'yes':U THEN
  DO:
    ASSIGN
      hSideLabel = hField:SIDE-LABEL-HANDLE
      hSideLabel:SCREEN-VALUE = '*':U + hSideLabel:SCREEN-VALUE NO-ERROR.
  END. /* if required is "yes" */
  END. /* if field edit manager valid */
  END. /* do to number of data fields in viewer */
END PROCEDURE.
```

Save and compile the viewercustom.p procedure.

**Invoking the field edits from an SDO**

The `rowObjectValidate` procedure in an SDO’s logic procedure has statements in it that are generated by the Object Generator, to verify, among other things, that mandatory fields (as designated in the Data Dictionary) are filled in. The code is in the following form for each mandatory field:

```asm
IF isFieldBlank(b_Customer.Comments) THEN
  ASSIGN
    cMessageList = cMessageList + (IF NUM-ENTRIES(cMessageList,CHR(3)) > 0 THEN CHR(3) ELSE ''':U) +
    {aferrortxt.i 'AF' '1' 'Customer' 'Comments' "'Comments"}.
END.
```

The presumption of the example is that you want to replace this standard check with a check based on the data you have entered into the field_edit table. So, you should edit the logic procedure of an SDO and replace these statements with a single call to `fieldEditValidate`. It will return a message string in the same format as that generated by the other validation checks, as shown:

```asm
Procedure rowObjectValidate:
/*---------------------------------------------------------------*/
  Purpose:     Procedure used to validate RowObject record client-side
  Parameters: <none>
  Notes:
---------------------------------------------------------------*/
  DEFINE VARIABLE cMessageList    AS CHARACTER    NO-UNDO.
  DEFINE VARIABLE cValueList      AS CHARACTER    NO-UNDO.
  RUN fieldEditValidate IN TARGET-PROCEDURE (OUTPUT cMessageList).
  ASSIGN ERROR-STATUS:ERROR = NO.
  RETURN cMessageList.
END PROCEDURE.
```
Testing the new manager

To test your new manager, build a window using the SDO that has the new version of rowObjectValidate. Either compile a static viewer for the SDO or recompile the dynamic viewer procedure ry/obj/rydynview.w to support your new behavior for all dynamic viewers. Add some records to the gsc_entity_field_edit table to define some edits for fields in the SDO. (These screen shots reflect the sample data entered using the procedure shown earlier in this section.)

Start the Session Type that uses the Field Edit Manager, and launch your window. The viewer should show the asterisk for each required field, as shown in Figure 7–7.

![Figure 7–7: Field Edit Manager session type](image)

If you blank out a required field and attempt to save that change, an error message such as the one in Figure 7–8 appears.

![Figure 7–8: Error message](image)

If you enter a state code in lower case, it automatically changes to upper case on Save.
Understanding the Repository Object Tables

This chapter describes those elements of the Progress Dynamics Repository that make up the definition of application objects, which include:

- Procedural objects such as SDO logic procedures, custom super procedures, and business logic procedures (PLIPs).
- Object types and the class hierarchy that defines a SmartObject.
- SmartObjects, both static and dynamic (though detailed information is stored in the Repository only for dynamic objects).
- Object instances as used on a particular container.
- Object attributes (properties).
- SmartObject links that define the communication path between objects.
- Page layouts and folder pages.

The following sections break down the object Repository into meaningful groups of related tables and discuss the nature of the data, how it can be generated, and how it is used at run time to realize a largely dynamic application:

- Architectural principles
- Object types, SmartObjects, and instances
- Attribute tables
- SmartLink tables
• Folder page tables
• Customization tables
• Using the Repository Manager
Introduction

Like other chapters in *OpenEdge Development: Progress Dynamics Advanced Development*, this one observes a convention of using the word **Object** with a capital O to denote an application component that has attributes and specialized behavior associated with it. Not all of these things are in fact SmartObjects. Database fields are represented in the Repository as **DataField objects**, and although these are not SmartObjects, they have attributes defined in the Repository that extend their behavior beyond simple **widget objects** such as buttons and ordinary fill-in fields. Procedures registered in the Repository are also objects with extended behavior beyond ordinary operating system procedures. Their relative pathnames and other information are stored in the Repository, allowing the framework to access and manage them more effectively.

While this chapter does not describe any one specific product feature, the information provided should serve as a basis for understanding all the framework features that either populate the object tables in the Repository (such as the Entity Import tool, the Object Generator, etc.) or read the information at run time to realize the application. It can also be used as a guide to anyone developing new tools and procedures that must read or write to the Repository.

The chapter describes the actual Repository tables and their fields in detail, in order to provide you with as complete an understanding of the Repository database as possible. However, you should always keep in mind as you read this material that Progress Dynamics includes an extensive API to provide both design-time and run-time access to the Repository, and any code you write that must use the Repository should always use this API, which will continue to be supported and kept compatible and consistent, even as changes are made over time to the underlying specifics of the data structure.

This material is of interest to Progress Dynamics application developers and is designed to help you to understand better how the framework operates. Remember that you can write complex and complete Progress Dynamics applications, including customizations and extensions to the framework and its object types, without ever writing a line of code that uses the Repository API, or accesses the Repository database directly. Knowledge of the Repository internals is of interest to those writing new tools to manage the Repository data in some way that goes beyond the support that is currently provided by the standard framework tools.

An example of this could be a custom migration tool that you build to convert your existing application, which, of course, has its own particular structure and architecture, into a Progress Dynamics-based application that is largely data-driven. Another example could be an application analysis tool that provides useful information to you about the structure of your application, such as a tool to analyze dependencies and provide you with information on the impact of changes, and so forth. Yet another example would be a new set of run-time driver procedures to read the data and create an interface for a new type of client platform.

Over time, the Progress Dynamics development team will endeavor to provide all developers with more useful tools of this type, but we will never be able to satisfy every user need, and we want you to be as independent as possible in your ability to provide yourself (and potentially others in the OpenEdge community) with the tools you need to complete and manage your application.
The Progress Dynamics Repository database contains tables that support many functions, from the definition of application components to user maintenance, security definition, session and configuration management, message maintenance, translation, deployment information, and more. This chapter focuses on those tables that support the definition of application objects, in particular those that are represented only as data in the Repository and which are then realized dynamically at run time. The tables that are used in other parts of the framework, such as session management and the APIs that provide you with access to that information, are described in other documents, including *OpenEdge Development: Progress Dynamics Managers API Reference* and *OpenEdge Development: Progress Dynamics Administration*.

The discussion in this chapter is broken down into logical groups of related tables, though nearly all the tables involved are related to one another in some way. Much of the basis for this documentation is taken from the extensive internal documentation in the ERwin model for the Repository database, and the reader with access to ERwin can refer to the model directly for the complete picture of the Repository database and all its tables.

**Architectural principles**

Progress Dynamics is based on the Application Development Model Version 2 (ADM2) and its SmartObjects. The definitions, and in particular some of the names, used in the Repository tables discussed here reflect that. Note, however, that while the term SmartObject, along with other ADM terminology such as SmartLink, is prevalent throughout this part of the Repository and certainly in this document, there is relatively little in the definition of the Repository schema or even in the data for a particular application that is specific to SmartObjects. A few characteristics, such as the definition of supported links and other details, are mapped to the definition of such things within the ADM2. However, there is nothing to prevent a developer from using the same schema and most of the same data to define application components that were not realized through the ADM.

In fact, as more and more objects become logical entities that are just a collection of records in the database, realized by some driver procedure at run time, the number of actual independent SmartObjects as such becomes ever smaller. The goal over time is that all application objects will be dynamically generated, and that only application-specific business logic will be defined in ABL source code procedures. Viewed in that way, the whole notion of a SmartObject application becomes unclear. The ADM then becomes nothing more than a convention for defining object properties and a particular set of procedures for creating them at run time and coordinating their behavior. Nothing would stop a developer from creating an alternative set of driver procedures to create a different interface and a different implementation of the objects’ behavior.

Indeed, a large part of why the Repository is valuable is that it reduces object definitions to an abstraction, so that an application can be realized on any platform, with any user interface, driven by the same data. The dynamic HTML interface for Web browsers in Progress Dynamics Version 2 is a perfect example of this. The client code running in the Web browser does not consist of SmartObjects in the same sense that it does when you run the application on an ABL Virtual Machine (AVM) run time client, but it reproduces almost all the same behavior by reading exactly the same data from the Repository. In large part, that is why this document exists: to help people understand how to write such driver programs and how to use the data provided for them.
Object IDs in the Repository

There are numerous references to *object IDs* in the table and field descriptions. The Repository schema observes the standard Progress Dynamics convention whereby every table in every database has a unique key called an object ID, a decimal value generated by a single trigger procedure to be an absolutely unique value throughout the database, and in principle, throughout the world. These fields always have a name consisting of the table name, minus the three-letter table prefix and underscore, plus the suffix _obj.

Although many of the tables in the Repository schema have other unique keys, and in some cases other values that can be used to join them to other tables, relationships between tables are almost always defined in terms of object IDs, where the object ID for a record in one table is a foreign key, or part of a foreign key, in another table. These object ID values are never meant to be displayed and would not be meaningful to any user. Because they are completely arbitrary values, they never are subject to change and therefore do not require rules about cascading of changes to other related tables. This principle is fundamental to the structure of the Repository, as it is to every database schema defined in observance of the Progress Dynamics design principles.

You can find other basic information about the Repository and its naming conventions in the chapter on Database Design Principles in *OpenEdge Development: Progress Dynamics Basic Development*. Throughout this chapter, we generally describe all the fields in each table except for the key fields. To aid readability, this chapter sometimes refers to Repository tables (after the first definition of them) without the table prefix.

Object types, SmartObjects, and instances

Every object in the application, whether static or dynamic, is registered in the Repository, and every dynamic object is fully defined by the data in the Repository. The record that identifies the object is stored in the ryc_smartobject table. The name SmartObject notwithstanding, objects of any kind, whether they are true SmartObjects or not, are identified here.

The class hierarchy that provides every object with its full definition is represented in the gsc_object_type table.

For every separate place an object is used, in a container or in some other specific context, the Repository holds an ryc_object_instance record to represent that particular use of the object.

This section describes these tables and their relationships in the following sections:

- Object diagram
- Object type table
- SmartObject table
- Object instance table
- SmartObject table example
Object diagram

The ERwin diagram in Figure 8–1 shows the object_type, smartobject, and object_instance tables, their fields, and their relationships.

Figure 8–1: Object diagram

Object type table

The Object Type table gsc_object_type really defines an object class. Object types are, in principle, hierarchical, so that an object type can inherit from other object types to define subclasses of other objects. Although this capability is not yet fully implemented in Progress Dynamics Version 2, the data structure is there to support it, and future releases will allow both the Progress Dynamics development team and application developers to define object types by subclassing other object types.
In the ADM2 code itself, of course, this is already done for SmartObjects, so that a SmartObject type, such as a SmartDataViewer, is defined in terms of a class hierarchy starting with `smart.p` and continuing down through `visual.p`, `datavis.p`, and `viewer.p`, and optionally `container.p`, if the viewer contains SmartDataFields. However, this hierarchy is not yet represented in the Repository itself and is defined by the nested include files that are part of the SmartObject’s code-based definition. What will happen in the future is that the definition of this hierarchy will be fully represented in the Repository itself, so that there is no need for the code that is currently compiled into the SmartObjects, including the procedures that act as drivers for objects defined in the Repository. When this happens, it will also be possible to define objects other than SmartObjects in the same hierarchical fashion, such as a class of widget, then a fill-in that extends the class of widget with specific attributes for fill-ins, then a class of date fill-ins, etc.

Object types are also used to define default values for many object attributes or properties, which are inherited by every object of that type that is created.

The gsc_object_type table has the fields described in Table 8–1.

**Table 8–1: The gsc_object_type table**

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>object_type_code</td>
<td>This CHARACTER field is a unique character string to name this type of object.</td>
</tr>
<tr>
<td>object_type_description</td>
<td>This CHARACTER field can hold any useful description of the object type.</td>
</tr>
<tr>
<td>disabled</td>
<td>This LOGICAL field determines whether security checking is enabled for the object type. If the field is set to YES, then this object type is not checked by the security mechanism and full access is granted.</td>
</tr>
<tr>
<td>layout_supported</td>
<td>If this LOGICAL field is set to YES, then this is a noncontainer SmartObject that might require a layout if built dynamically.</td>
</tr>
<tr>
<td>static_object</td>
<td>Every ryc_smartobject record has a static_object field that identifies whether the object is either static, that is, having its own procedure file or dynamic, that is, generated strictly from data in the Repository. This LOGICAL field defines a default value for that static_object field for all objects of the type.</td>
</tr>
<tr>
<td>deployment_type</td>
<td>This CHARACTER field determines where objects of this type should be deployed. As with the static_object field, the field acts as a default for the deployment_type field stored in every ryc_smartobject record for the type. Valid values for this field are SRV for remote server only, CLI for client only, WEB for Web browser objects, or combinations as required, represented as a comma-delimited list, for example, CLI,SRV. This field assists developers in deploying applications on AppServers by helping define which objects should reside where.</td>
</tr>
</tbody>
</table>
SmartObject table

The ryce_objects table has a record for every application element that can be considered an object. This includes SmartObjects, DataFields (the Repository’s record of database fields from the application), and procedure files that are in any way maintained or controlled through the framework.

Note: Progress Dynamics Version 1 users might be aware of a gsc_object table. The gsc_object table has been merged into the ryce_objects table.

In the case of dynamic SmartObjects, every piece of information about the object definition is stored in the Repository, and its ryce_objects record acts as a header for all those other related records. In the case of procedures, they can be registered in the Repository so that they can be related to other objects.

Procedural objects have a SmartObject record and possibly other related records for security or other purposes, but their definition is largely in the ABL source code in the procedure itself. Procedures that must be registered in the Repository include:

- Business logic procedure (PLIPs) that are run in the application.
- Procedures that are run as the action of some menu or toolbar item.
- SmartObject class super procedures such as smart.p logic procedures for SDOs.
- Custom super procedures for dynamic objects.

Because the table holds information for many kinds of objects, not all of its fields are meaningful or used for all objects.

Objects must be assigned an object type and belong to a product module. This facilitates setting up security based on object types and modules, rather than having to secure every object individually.

### Table 8–1: The gsc_object_type table

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>class_smartobject_obj</td>
<td>An object type can be supported by a procedure that defines behavior for the type. This is the case for SmartObject classes, and might be true for other object types as well. If there is a class procedure for an object type, it is registered in the Repository in the ryce_objects table, like any other procedure. This object ID field points to that class procedure if it exists.</td>
</tr>
<tr>
<td>extends_object_type_obj</td>
<td>This object ID field defines the hierarchical relationship between object types. If it is defined, it points to the “parent” object type that the current object type extends or inherits from.</td>
</tr>
<tr>
<td>product_module_obj</td>
<td>Every object type is registered in a product module, and this object ID points to that record.</td>
</tr>
</tbody>
</table>
The SmartObject table supports both physical (static) and logical (dynamic) objects. If the SmartObject itself is a physical, procedural object, then the link to the physical object in the SmartObject record (the field `physical_smartobject_obj`) is set to 0. This is because a static SmartObject does not require another procedure to realize it at run time. If it is a dynamic object, then the link to the physical object points to the procedure to use as the starting point when instantiating the dynamic object at run time. In other words, a logical object, such as a SmartDataBrowser, is represented by a record in this table whose `physical_object_obj` value points to the procedure responsible for instantiating all dynamic SmartDataBrowsers.

If the object is flagged as a `generic_object`, that is, a physical object that is the driver for a class of dynamic objects, then no security allocations, menus, etc. can be allocated to it, as it is useless without the dynamic portions being built first against the logical objects that use it.

The name of the object is stored in the `object_filename` field. Note that this is a bit of a misnomer, since most objects in this table are not files on disk at all. For logical objects, the object name is specified without a file extension, and the path is not relevant. For procedural objects, the name might or might not include the filename extension, depending on how the procedure is registered. Logic procedures created by the Object Generator, for example, do not have the `.p` extension as part of the object name. Procedures that are registered through the AppBuilder, using its `File → Register In Repository` option, do have the extension as part of the `object_filename`. In either case, the extension for a procedure is also stored in a separate field. The `object_path` field provides the relative pathname information to locate the object.

All objects have an `object_type_obj`. This points to the definition of the object type in the `gsc_object_type` table. Security allocations can be defined against an object type so that they apply to all objects of that type without each individual object needing a security allocation. Object types are also used to define default values for many object attributes or properties, which are inherited by every object of that type that is created.

The `ryc_smartobject` table contains object IDs pointing to its layout, its object type, its `product_module`, another object that it can be run by, and if this object displays data for an SDO, its related `sdo_smartobject`. This table contains the following fields:

- **object_filename** — This CHARACTER field is either the physical filename (with or without extension) of a static object or the logical name of a dynamic object. It is important to note that the `object_filename` by itself is not a unique key for the SmartObject table. If an object has customizations, which basically means special attribute values for a particular user, UI Type, or other situation, then there will be multiple SmartObject records with the same `object_filename`. The primary record, which links to all of the default attributes for the object, will have a `customization_result_obj` of 0. Other records will have the same `object_filename` along with a `customization_result_obj` pointing to a record in the `customization_result` table. Therefore, you must include the qualifier **AND** `customization_result_obj = 0` in any query against the SmartObject table if you want to retrieve only the primary record for the object. See the separate description of customization support for more information.

- **object_description** — This CHARACTER description is used as the default for a menu label.

- **static_object** — This LOGICAL field indicates whether the object is static or dynamic. Static objects are registered in the Repository so that they can be used as instances within smart containers. Dynamic objects exist in the Repository so that they can be constructed at run time.
• **system_owned** — If this **LOGICAL** field is set to **YES**, then the SmartObject record can only be modified by users with a system-owned flag. This field occurs in many tables throughout the Repository to safeguard basic records without which the framework or an application cannot function properly.

• **shutdown_message_text** — This message text is displayed if the user attempts to close down this object while it contains unsaved changes.

• **template_smartobject** — If this **LOGICAL** field is set to **YES**, then this SmartObject can be used as a template for creating other similar SmartObjects. This makes it easy to define standard containers, such as a window with a standard toolbar, a standard browser, or a standard layout, and to create new objects based on this template.

• **object_path** — This **CHARACTER** field is the relative file system path to the object. This must contain forward slashes for portability. A relative path should always be used rather than an absolute path. The path must be relative to the workspace root directory. Because this path is stored in the Repository, it is never necessary to identify a procedure within the Repository by including its relative path; the object name will suffice. For example, when you associate a custom super procedure with a dynamic object, you simply provide its name, which the tools verify is the name of a registered procedure. At run time, the framework constructs the full pathname by prepending the **object_path** to the **object_filename**, in order to run the procedure.

• **object_extension** — This **CHARACTER** field holds the filename extension for a procedure file, such as `.p` or `.w`. This is true whether the **object_filename** has the extension as part of the name or not. The framework uses this to construct the full filename at run time.

• **container_object** — If this **LOGICAL** field is set to **YES**, this object is a container window. Only container windows can appear on menus, and only container windows can have a dynamic menu structure.

• **generic_object** — If this **LOGICAL** field is set to **YES**, this is a physical generic object used as the starting point for building a dynamic object and is not a complete object in itself. For example, the procedure `rydyncontw.w` is the procedure that is used to create all dynamic windows at run time. This is registered in the Repository as a generic object, and every other SmartObject that is itself a dynamic window points to this record as its **physical_smartobject_obj**.

• **required_db_list** — This **CHARACTER** field is a comma-delimited list of logical database names that must be connected in order to run this object. If any databases are specified and the databases are not connected, then the program is prevented from running, and the menu option/buttons it appears on are disabled, etc.

• **runnable_from_menu** — If this **LOGICAL** field is set to **YES**, this object can be run from a menu. Objects such as browsers and viewers cannot be run on their own from a menu. Object controllers and menu controllers can always be run from the menu. Smart windows can sometimes be run from a menu, depending on whether they maintain a specific record or not, that is, whether they are dependent windows that require a key to be passed to them as input. If this flag is set to **NO**, this object cannot be placed on a menu or dynamic toolbar.

• **disabled** — If this **LOGICAL** field is set to **YES**, access to this object is disabled, regardless of any other security settings.

• **run_persistent** — If this **LOGICAL** field is set to **YES**, this object is run persistently. This is used only for static objects.
• **run_when** — This CHARACTER option defines the following circumstances under which this program can be run:
  
  – **ONE** — Only one instance of this program can be run at a time.
  
  – **NOT** — This program can only be run when there is no transaction open.
  
  – **ANY** — This program can be run anytime.
  
  – **NOR** — This program can only be run when no other programs are running. While it is running, no other programs can be started.

  **Note:** This field is not yet actively used.

• **deployment_type** — This CHARACTER field holds the deployment type for the specific object. Its value is normally inherited from the `gsc_object_type` table and the field is described there.

• **design_only** — This LOGICAL field identifies the object as being required only during design or development time. The flag allows the framework to identify which objects to deploy when it is building a run-time-only deployment package that does not require any objects that are used to build the application. The default field value is **NO**.

• **custom_smartobject_obj** — This DECIMAL field points to a custom super procedure used to provide behavior for a dynamic object. The procedure itself must also be registered in the SmartObject table. This allows its object ID to be stored in this field for each SmartObject it is associated with.

• **extends_smartobject_obj** — This DECIMAL field enables class inheritance for objects so that the actual object super procedure hierarchy can be represented in the Repository, and also so that non-DataFields, can be defined in terms of a hierarchy of domains that define increasingly specific behavior for types of fields. Although this behavior is not yet implemented in Version 2, the Repository structure is present to allow it to be done in a future release.

• **physical_smartobject_obj** — As noted in the description of the `generic_object` field, some SmartObject records represent the driver procedures that create dynamic objects at run time. If a record represents a dynamic SmartObject, this DECIMAL field holds the object ID of the generic object that realizes it at run time.

• **security_smartobject_obj** — This DECIMAL field is usually the same as the `smartobject_obj`. It indicates that security is enabled for the object and that this object is used for any security checks. If this field is set to 0, security checking is disabled for this object. A different object can be specified as the security object if this is required to make setting up security restrictions easier. For example, all objects on a container can point at the container object for their security. Possibly an entire suite of objects can point at the same security object, such as the menu.

• **customization_result_obj** — This DECIMAL field can contain the object ID of a record in the `customization_result` table, and if it is defined, it is combined with the `object_filename` to identify the SmartObject record for a particular customization of a base SmartObject. This is described in more detail in a separate section on customization.
Object instance table

The *ryc_object_instance* table contains a record for each instance—each distinct usage or context within the application—of each SmartObject. This, therefore, represents a running instance of an object on a container, and every SmartObject instance is identified and distinguished based on the container in which it is run, that is, the context that makes the use of the object distinct. The *object_instance* table facilitates the allocation of specific attributes, links, and page numbers for the specific instance of an object.

The table holds object IDs that point to its container (*container_smartobject_obj*), the SmartObject that it is an instance of (*smartobject_obj*), its object type (*object_type_obj*), and its product module (*product_module_obj*). It also has these other fields:

- **system_owned** — If this LOGICAL field is set to YES, this record can only be modified by users with a system-owned flag.

- **layout_position** — This CHARACTER field is a code indicating where in the layout of a container the object belongs. The Layout Manager then uses this to automatically position objects at run time. The standard layout used for all container windows you build using the framework is now the “relative” layout, and for this layout type, the *layout_position* is always a three-character code. The first character is M if the object is anywhere in the main section of its container (which effectively means anywhere except the bottom line) or B if it is on the bottom line. The second and third characters are digits representing the row and column of the object, corresponding to the grid position you assign to it in the Container Builder. The row corresponds to the row 1–9 in the Container Builder grid. The column number corresponds to the column A–J of the Container Builder grid. For older containers, which mostly means container windows that make up some of the framework tools themselves, such as the windows on the Progress Dynamics Administration menu window, other layout types are used, and in this case the *layout_position* is something different, for example, top, center, bottom, etc. These other layout types are supported for backward compatibility only.

- **instance_name** — The instance name CHARACTER field identifies the object instance uniquely within a container. It can simply be the same as the object name, or it can be changed to distinguish between two occurrences of the same object in the container (such as a toolbar used in two different places in the container). In the case of SDOs as containers for DataField objects, this name field holds the actual name of the field to use in the SDO field list. It should, therefore, never contain a table name or other prefix. Usually, the name matches the object name of the DataField object, but can differ, for example, where two tables exist in a single SDO with common field names. The use of the name field emulates the alias functionality that exists within SDOs, where a database field can be renamed in an SDO. In the case of an object used in a container, the field holds the name given to the instance in the Container Builder. This can be the same as the object name, or it can be different to distinguish between multiple instance of the same object in a container, or to identify its specific use within the container.

- **instance_description** — The instance description CHARACTER field defaults to be the description from the , but it can be changed to describe the use of the object within the container, such as “top container toolbar” or “toolbar for order browser.”
SmartObject table example

To illustrate the relationships among these tables, we use an example from Chapter 3, “Advanced User Interface Design,” the Order Entry Maintenance window oemaintwin. Figure 8–2 shows a rough sketch of the object type, SmartObject, and object instance records that make up Page 0 of this window.

![Diagram of SmartObject table example](image)

**Figure 8–2: Order entry maintenance window records**

It is too complicated to show all of the connections for every object. Those that are here show the relationships from the window itself, which you can then extend to apply to all the other objects. To simplify the diagram a bit, we have left off the table prefixes.

To follow the diagram, start with the container window itself, the SmartObject oemaintwin. This is the master record for the window. When the framework must run this window, because of a request from the Dynamic Launcher, from the AppBuilder, or from an action defined for a menu or toolbar item, it locates this record to determine what to do.

There are five principal connections between the SmartObject record and other records that help to define it:

- First, there is a pointer to its object type record, the type DynObjc, or independent window. This record in turn is connected to a number of attribute value records that define default attribute values for all windows of this type, as well as other information. For more information on attribute values and other relationships, see the “Attribute tables” section on page 8–14.

- Next, there is the product_module record, which identifies this window as being in the ÖE product module.
Next, there is a pointer to the Layout record for the Relative layout, the one used for all windows built in the framework. This holds, among other information, the name of the procedure that does the layout at run time, _rylayoutsp.p_.

Finally, there are pointers to two other SmartObject records. The custom_smartobject_obj pointer connects to the SmartObject record that defines the custom super procedure for the window, the procedure _oemaintwinsuper.p_. And the physical_smartobject_obj pointer connects to the SmartObject record that defines the generic object for dynamic windows, the procedure _rydyncontw.w_, which reads all these records and creates the window at run time.

Those are the records from the object_type, SmartObject, and object_instance tables that together describe the window itself as an object. Just as some of its attributes come through the object type, the window SmartObject record also points to attribute value records for attributes defined at the master level of the window. For more information on attributes defined at the master level, see the “Attribute values defined at the object instance level” section on page 8–23.

Of course, the window is just a container for other objects. These are represented as object_instance records because they are instances of other SmartObjects as used in this window. In this case, there are two object_instance records for the two objects on Page 0 of the window (as well as others for the other pages that we have left off here for simplicity), the FolderPageTopToolbar instance and the folder object instance of _afspf0ldw.w_.

Each of these object_instances in turn points to its own SmartObject record for the master object. Again, some of each object’s attributes are defined in the master, some are defined for the instance, and some are inherited from each object’s class (object type).

### Attribute tables

Objects of all types can have many attributes or properties (the terms are interchangeable as used in this material) that are stored in the Repository. Developers can define attributes and then associate them with one or more object types. For SmartObjectss, these attributes are the same as the ADM2 properties that are defined in the property include files associated with each SmartObject super procedure class, such as _smrtprop.i_, _cntnprop.i_, and so forth. In the standard Version 9 ADM code, these include files actually define the attributes for each class, by building up a dynamic temp-table with a field for each attribute. If a SmartObject, such as a SmartDataBrowser, inherits from numerous classes, such as _Smart, Visual, DataVis_, and _Browser_, then its properties are the sum of all the properties defined for each of those classes, and its individual temp-table has a single record with a field for each of those properties.

This same mechanism is used for SmartObjects in Progress Dynamics. However, all the properties are defined in the Repository, so that the property include file definitions are not needed. This provides much improved flexibility, because you can add a new attribute to an object type by defining it in the Repository without having to recompile every SmartObject of that type. For compatibility with ADM2 applications that do not use Progress Dynamics, the property include files are still present and are still used to compile those non-Progress Dynamics SmartObjects. However, SmartObjects in a Progress Dynamics application do not use the contents of the include files and instead build their temp-tables up from the records in the Repository.
Other kinds of objects can have attributes as well, in exactly the same way. DataFields, for example, which are the Repository's representation of application database fields, also have attributes that are built up in the same way, even though they are not SmartObjects. Procedures and other kinds of objects recognized by the Repository also have attributes.

As shipped with the product, the Repository includes definitions for all the attributes used by the framework and its standard objects. These are defined in the `ryc_attribute` table, which has a record for each distinct attribute.

The `ryc_attribute_group` table facilitates the logical grouping of attributes to simplify their use. The primary use of this table is to make the presentation of the attributes to the user more effective and usable. There is an `attribute_group` record for each SmartObject class that defines attributes, such as Smart, Visual, DataVis, Query, etc. There is also a large `attribute_group`, called WidgetAttributes, with all of the field-level attributes that map to built-in ABL widget attributes. There are other attribute groups as well. You can specify the attribute group in various framework tools to help you locate and organize attributes.

There is a record in the Repository for every attribute value of every object in the application. Some of these are defined at the object type level. These are default values for attributes for every object of a given type. Each individual object master can also have its own attribute values, and each instance of that object can have its own distinct values for attributes. The `ryc_attribute_value` table holds all of those values, one value per record. Each attribute value record is linked to either the class, the master object, or the instance for which it is defined. Any attribute value that is inherited by a master from one of its classes, or by an instance of a master, is only stored at the highest level, to reduce the data in the Repository and to facilitate an inheritance mechanism whereby any change to an attribute value at a higher level is automatically inherited by every object of that type that does not specifically override the default.

Figure 8–3 is an excerpt from the Repository database and shows the relationships between the attribute tables.
Attribute group table

The ryc_attribute_group table has the following fields:

- **attribute_group_name** — This CHARACTER field is the name of the group, such as Smart, or WidgetAttributes.
- **attribute_group_narrative** — This CHARACTER field is a free text description of the type.

Attribute table

The ryc_attribute table has these fields:

- **attribute_label** — This CHARACTER field is the name of the attribute. For SmartObject attributes, this is the same as the name in the property include files. For widget attributes, the name is normally the same as the ABL attribute name (including hyphens, which are otherwise normally avoided in attribute names).
- **attribute_group_obj** — This DECIMAL object ID points to the attribute group for the attribute.
- **data_type** — This INTEGER field holds the data type of the attribute. As you will see in the description of the fields for the attribute_value table, Progress Dynamics supports a list of attribute data types corresponding to the native ABL data types, and stores the attribute value in a field of that data type. This field, therefore, identifies which of the attribute value fields actually holds the value for the attribute. Progress Dynamics Version 1 users might be aware that there was an ryc_attribute_type table in Progress Dynamics Version 1. This table has been removed, as the type was really nothing more than the data type, which is now stored here. This is an INTEGER field for performance reasons. The valid values are as follows:
  - 1 — Character
  - 2 — Date
  - 3 — Logical
  - 4 — Integer
  - 5 — Decimal
  - 6 — Reserved
  - 7 — Recid
  - 8 — Raw
  - 9 — Rowid
- 10 — Handle
- 11 — Memptr
- 12 — reserved
- 13 — reserved
- 14 — Com-handle

These values map to the values used in ABL and other OpenEdge tools.

- attribute_narrative — This CHARACTER field provides a full description of the purpose and use of the attribute.

- override_type — This CHARACTER field indicates whether the standard get and set functions must be used to set and retrieve the attribute value. Normally, these functions serve only to permit other application objects to access the properties of a SmartObject, and for access within the object itself and its super procedures, code can directly access the temp-table that holds the object’s attribute values. In that case, this field is blank. Other values this field can take are get, indicating the get function does something specific to retrieve the value and must be executed, set, indicating the set function must be executed to set the value, or get, set indicating both the get and the set functions must be executed. If this field has a value, then the functions to get and/or set this property need to be defined. The functions are executed instead of simply accessing the value directly in order to allow them to contain additional logic beyond simply retrieving the value from the temp-table. This is the equivalent of defining the xp preprocessors in the property include files of the ADM, but is more flexible in that it differentiates between get and set.

Note that in code that checks this value, a CAN-DO or LOOKUP should be used to ensure the order of the get, set pair is irrelevant.

- runtime_only — This is a LOGICAL field that defaults to NO. If it is set to YES, then the value of this attribute should not be stored in the Repository and is only to be added to the attribute temp-table at run time without an initial default value. An example would be an attribute that stores a handle, as the handle has no context outside of the current session, but still needs to form part of the valid attribute list. Other examples are attributes that store the current state of an object, such as ObjectInitialized. There would be no point to assigning such attributes a default value. This field is useful in that it permits tools, such as the dynamic property sheet, to filter out attributes that it is not meaningful to assign a value to at design time.

- is_private — This is a LOGICAL field that defaults to NO. If it is set to YES, then the value of this attribute is not intended to be accessed outside of the class where it is defined. This field is also used to filter out attributes from the dynamic property sheet and other tools. Generally, get and set functions are not defined for private attributes.
• **constant_level** — This is a CHARACTER field and identifies the level at which a property can be modified. The valid values for this are class, indicating it can only be specified at the class level, master, indicating that the value can be modified at the master level, and blank, indicating that there are no restrictions on where the attribute can be assigned a value. This field also assists tools, such as the dynamic property sheet, in filtering out attributes from its display. An attribute, such as ObjectType, is defined once for the class and should not be changed in a master or instance. A master attribute, such as the ObjectName, should not be changed in an instance. Thus, the dynamic property sheet and other tools disable updates to attributes with a constant_level of class when you are defining a master or instance, and disable updates to attributes with a constant_level of master when you are defining instance attributes for an object in a container. There is also a constant_value field in the attribute_value table that is a LOGICAL indicating whether further modifications are allowed to the property. The attribute table's constant_level field therefore affects how the constant_value flag is set in the attribute_value table.

• **derived_value** — This is a LOGICAL field that defaults to NO. It can be set to YES to indicate that the property value is derived from other properties or other run-time information and doesn’t need to be defined in the attribute temp-table or stored in the Repository. Its value is therefore always set and retrieved using its get and set functions, which must contain the code needed to determine the value. As an example, the Visual class has three attributes that provide information derived from the getSysColor built-in function and the COLOR-TABLE ABL object. These are called color3DFace, color3DHighlight, and color3DShadow. Because the attribute values are always derived from this system function, there is no need to store the value in the attribute temp-table. Code must always use the get functions to retrieve the values.

• **lookup_type** — This CHARACTER field defines the supported means of validating the attribute value for a specific object type. It is used in the dynamic property sheet to determine whether to overlay a combo box, a lookup button, or nothing at all on the attribute value field. Possible values are:

  - **LIST** — If the lookup_type is LIST, then the lookup_value field described next contains a string of possible attribute values in list-item-pairs format. In the property sheet, a combo box containing these values will overlay the attribute value field, so that the user must select one of the defined values for the attribute.

  - **DIALOG** — In this case, the lookup_value field contains the relative path and filename of a dialog container where the attribute value can be selected. In the property sheet, a lookup button will overlay the attribute value field. When the user selects the button, the specified dialog box is launched. The user can also enter a value directly without using the dialog.

  - **DIALOG-R** — This is like the DIALOG option, but makes the attribute value field read-only, forcing the use of the dialog box. This is necessary for dialog boxes that would return delimited lists that you would not want users to enter manually, or simply to control the value entered.

  - **PROC** — Here, the lookup_value field contains the relative path and filename of a procedure to execute to determine the list of valid attribute values in some special way. The ABL RETURN-VALUE of the procedure must contain a string of the list-item-pairs used to populate the combo box that overlays the attribute value field.

  - **""** — Blank indicates a free text entry. The dynamic property sheet simply enables the browse cell in this case so that the user can enter a value.
• lookup_value — This CHARACTER field can be used to specify a list of distinct values allowed for this attribute, or it can specify a procedure call that returns a list of values, or it can specify the name of a dialog box, as discussed in the description of lookup_type. When it contains a list, the delimiter must be CHR(3) rather than a comma, to allow for the possibility that a value might itself contain a comma. The value and format of the lookup_value field are dependent on the value of the lookup_type field, as follows:

– If the lookup_type is blank, then the lookup_value field is blank. Here, there is no restriction on the value the user can enter, and also no assistance in choosing a value.

– If the lookup_type = LIST, then the lookup_value specifies the LIST-ITEM-PAIRS values. This is a delimited list of labels and values in the form: label1,value1,label2,value2,...

– If the lookup_type = DIALOG, then the lookup_value specifies the relative path and filename of the dialog box to be run from the property sheet. The dialog procedure must return two OUTPUT parameters, the first a LOGICAL indicating whether the property was changed, and the second a CHARACTER output parameter containing the value, for example, RUN colorChooser.w (OUTPUT OK, OUTPUT cValue).

– If the lookup_type = PROC, then the lookup_value field specifies the relative path and filename of an external procedure to be run from the property sheet at initialization, which returns a delimited list of list-item-pairs.

• design_only — If this LOGICAL field is set to YES, then this attribute is only modifiable at design time, not at run time. The default is NO.

• system_owned — If this LOGICAL field is set to YES, this attribute can only be modified by users with a system-owned flag in their privilege definition. Certain attributes are required for the application to function correctly, and these are set to system_owned to prevent accidental deletion. Only users classified as able to maintain system_owned information can manipulate this data. In many cases, the actual attribute label must match to a valid ABL-supported SmartObject property.

Attribute value table

The ryc_attribute_value table contains these fields:

• constant_value — This LOGICAL field is set to YES if the value cannot be modified at any lower level of object definition. Its value is therefore YES if the attribute value is for an object type and the constant_level field of the corresponding attribute is class. Its value is also YES if the attribute value is for a master object and the constant_level field of the corresponding attribute is master. This field simply allows the constant_level to be verified in the attribute_value without having to refer back to the attribute record.

• attribute_label — This CHARACTER field is the name of the attribute as defined in the ryc_attribute record. Note that this is the join field used to relate this table to the ryc_attribute table when necessary.
The data_type field in the ryc_attribute table identifies the native data type of the attribute. Depending on that value, the actual attribute value is stored in one and only one of the following six fields; the others are unused. This allows the framework to avoid very frequent conversions back and forth to and from CHARACTER types.

It also avoids globalization issues that can be caused when locale-sensitive values, such as decimals (containing either a comma or decimal point) or dates (with different ways to order the month and day), are converted to CHARACTER strings. The types are as follows:

- **character_value** — Attribute values of type CHARACTER are stored in this field.
- **integer_value** — Attribute values of type INTEGER are stored in this field.
- **date_value** — Attribute values of type DATE are stored in this field.
- **decimal_value** — Attribute values of type DECIMAL are stored in this field.
- **logical_value** — Attribute values of type LOGICAL are stored in this field.
- **raw_value** — Attribute values of type RAW are stored in this field.

The ryc_attribute_value table also contains object IDs that point to the object type of the object with this attribute value, as well as the Product Module of the object. There are also pointers that identify whether this is a class, master, or instance attribute value. These are discussed next.

**Identifying the level of an attribute value**

Because the attribute value can be associated with any of three other tables (gsc_object_type, ryc_smartobject, or ryc_object_instance), it is necessary to identify which of the tables the value relates to. This tells us whether this is:

- A default value for an object type.
- A default value for a object master.
- A value for an individual object instance.
The `ryc_attribute_value` table contains an `object_type_obj` object ID field, a `smartobject_obj` object ID, and an `object_instance_obj` object ID. There is also an object ID field for the `container_smartobject_obj` if this value is for an `object_instance`.

Figure 8–4 is a diagram from the database model and illustrates how these fields relate the `attribute_value` to the `object_type`, `smartobject`, and `object_instance` tables.

Figure 8–4: Attribute value and table relationships

The following sections describe the different ways these fields can be used:

- Defining attributes at the object type level.
- Defining attribute values at the object master level.
- Attribute values defined at the object instance level.
- Code examples for an attribute value at the class level.
- Code examples for an attribute value at the master level.
- Code example for an attribute value at the instance level.
**Defining attributes at the object type level**

When the framework creates entries for attributes of an object type, the object_type_obj points to the object Type class, and the SmartObject and instance object IDs are set to 0.

To illustrate, Figure 8–5 shows an example diagram for the NavigationSourceEvents attribute, defined for the Query class. A Query object, such as an SDO, subscribes to various events in its Navigation-Source, and this attribute lists those events. These are defined at the class level and normally not changed by individual objects built using the class. So we can expect that there will be a single ryc_attribute_value record in the Repository database for this attribute for the Query class, but no other records for specific SDOs in the application. Figure 8–5 shows the relationships for the attribute_value record in this case.

![Figure 8–5: NavigationSourceEvents attribute](image)

Here you see that only the object type relationship is defined for attribute values that are default values for a class.

**Defining attribute values at the object master level**

When the framework creates entries in the table for an object master, it populates the object_type_obj field to avoid having 0 in the key. It also sets the smartobject_obj to point to the ryc_smartobject record that defines the object.
To illustrate this case, Figure 8–6 shows the relationships for the MinHeight attribute of the dynamic viewer customerviewv. This attribute sets an object’s initial height and is defined when the object is created. Because viewers come in all different sizes, this attribute is defined at the master level, along with the MinWidth attribute, to define the size of the viewer. You can see this attribute in the dynamic property sheet for the viewer when you edit it in the AppBuilder.

![Figure 8–6: Attributes defined at the object master level](image)

Figure 8–7 shows how the attribute_value record is related to other records.

![Figure 8–7: Relationships of attribute value records to other records](image)

In Figure 8–7, you can see that the SmartObject relationship is defined for the attribute_value because it is a value for a particular SmartObject. Because this is the master for the object, there is no instance or container relationship.

**Attribute values defined at the object instance level**

When the framework creates attributes for an object_instance, it populates the object_type_obj and the smartobject_obj fields, and also sets the object_instance_obj field to point to the ryc_object_instance record that defines the instance, as well as the container_smartobject_obj field, which points to the container’s ryc_smartobject record.
To illustrate this case, we can extend the second example to show another attribute of the same dynamic viewer. In this case, we pick an attribute that can be changed at the instance level, such as DisableOnInit. You can change this from its default value of No to Yes in the dynamic property sheet, as shown in Figure 8–8.

![Figure 8–8: Attributes defined at the object instance level](image)

If you do this in the Container Builder, when you are building a window such as the oemaintwin example, you are changing the attribute value just for that single instance of the viewer, as used in that window. The framework creates an attribute_value record to represent this overridden value and connects it to the object type, the viewer SmartObject, the object instance record for the viewer instance, and the SmartObject record for the container window.

Figure 8–9 shows the relationships for the instance attribute_value.

![Figure 8–9: Instance attribute value relationships](image)
The container_smartobject_obj points to the SmartObject for the window, and the object_instance_obj points to the instance of the viewer created for this window. When you place the viewer into the window in the Container Builder, you are creating an object_instance for it, which can have its own instance name and its own attribute values, as shown in Figure 8–10.

Figure 8–10: Object instances in the container builder window

All of this means that there are several different combinations of object ID pointers that framework code must check for to determine the level of an attribute value and what object it is defined for. To assist in this, another object ID field holds the meaningful identifier for the value, so that code can look at a single field to determine what the significant key is. This field is called the primary_smartobject_obj. This field contains the value of the container_smartobject_obj if that is not 0; otherwise the smartobject_obj if that is not 0; otherwise 0. It is used as the replication key field when writing replication triggers to cascade changes to the version database, as the replication triggers could not handle the use of alternative fields (for example, container_smartobject_obj or smartobject_obj). The update of this field is done in the write trigger for the table.

Note: Be careful when looking for attributes associated with an object_type. Make sure that you look for the specific object_type and 0 values for the SmartObject and object_instance object ID fields.

This might all sound complicated, but the rules that determine which fields are used are fairly straightforward. We can summarize all this with some code samples in the following sections.

Code examples for an attribute value at the class level

If an attribute value is defined for an object type or class, then the object_type_obj is defined and points to the object_type record. The other object IDs, for SmartObject, instance, and container, are not defined (therefore 0), because the value is not associated with a specific object. You can determine all the default attribute values for a class by retrieving the attribute_value records for which smartobject_obj, object_instance_obj, and container_smartobject_obj are all 0.
The next example shows a simple code block that locates all the object type records for the NavigationSourceEvents attribute. The code retrieves only records where the smartobject_obj is 0. (If this is the case, then object_instance_obj and container_smartobject_obj are also 0.) This locates the attribute values defined at the class level, as shown:

```
FOR EACH ryc_attribute_value WHERE
    attribute_label = 'NavigationSourceEvents' AND smartobject_obj = 0:
        FIND gsc_object_type OF ryc_attribute_value.
        DISPLAY object_type_code character_value FORMAT "x(40)".
END.
```

This result in Figure 8–11 shows that there are two classes that define this attribute.

![Figure 8–11: Class level attribute value](image)

We have already discussed the Query class. The Container class uses this attribute because a container can be a pass-through object for a Navigation link coming in from outside the container. We can see that both classes define the same initial value for the attribute. Because it’s a CHARACTER attribute, the value is stored in the character_value field.

To confirm that this attribute does not change below the class level, you can leave out the WHERE clause qualifier AND smartobject_obj = 0. For example:

```
FOR EACH ryc_attribute_value WHERE
    attribute_label = 'NavigationSourceEvents' /* AND smartobject_obj = 0 */:
        FIND gsc_object_type OF ryc_attribute_value.
        DISPLAY object_type_code character_value FORMAT "x(40)".
END.
```

When you run this, the result is the same: only the two records show up. So, no master SmartObjects override this default value.

**Code examples for an attribute value at the master level**

If an attribute value is defined for an object master, then the significant pointer is the smartobject_obj, which joins the record to the SmartObject record for the master object. The object_type is also filled in the previous example.
Another simple code block illustrates this relationship. The code looks for any attribute_value for the MinHeight attribute that has a SmartObject object ID. These all join to a SmartObject master. We only want to see those values that are defined for the master and not for one of its instances, so we also include the qualifier object_instance_obj = 0. For example:

```
FOR EACH ryc_attribute_value WHERE attribute_label = 'MinHeight'
    AND smartobject_obj NE 0 AND object_instance_obj = 0:
    FIND ryc_smartobject OF ryc_attribute_value.
    DISPLAY object_filename FORMAT "x(20)" decimal_value.
END.
```

This is the result of the request. Figure 8–12 shows the customerview viewer among the objects with an assigned MinHeight value.

![Figure 8–12: Objects with assigned minimum height values](image)

To find out which object types have a MinHeight defined for the class itself, look for object types where the smartobject_obj is equal to 0. For example:

```
FOR EACH ryc_attribute_value WHERE attribute_label = 'MinHeight'
    AND smartobject_obj = 0:
    FIND gsc_object_type OF ryc_attribute_value.
    DISPLAY object_type_code FORMAT "x(20)" decimal_value.
END.
```
There are in fact a few classes that define an initial value for the MinHeight, as shown in Figure 8–13.

**Figure 8–13: Classes with defined initial values for MinHeight**

In this example, the default height for a dynamic browser is 6.67 rows. Because the browser is a resizable object, this value applies initially to all dynamic browsers, unless you set it otherwise for the master or for an instance of the master in a window. By contrast, the dynamic viewer class does not have a default for MinHeight, because the height of the viewer is always determined by the layout of the fields it contains.

**Code example for an attribute value at the instance level**

If an attribute value is defined for an object instance, then there are really three significant pointers. As for the master attribute, the smartobject_obj joins the attribute_value record to the master SmartObject. In addition, the object_instance_obj joins the record to the object_instance of the SmartObject it’s defined for. Because the instance is always defined in the context of a particular container, the container_smartobject_obj is also defined and points to the SmartObject record of the container window. Again, for completeness, the object_type_obj is also filled in.

The following code is an example of this relationship using the DisableOnInit attribute. This block of code locates all attribute_value records where the DisableOnInit attribute has been set to YES at the object_instance level.

The code follows the join to locate the master SmartObject record for the value. It also follows the join to the object_instance for the value, from which it displays the layout position. Then it follows the join to the SmartObject record for the container. Because there are two different SmartObjectss the attribute value joins to, the master and the container, the code needs a second buffer for the container, as shown:

```plaintext
DEFINE BUFFER container_smo FOR ryc_smartobject.

FOR EACH ryc_attribute_value WHERE object_instance_obj NE 0 AND attribute_label = 'DisableOnInit' AND logical_value = YES:
    FIND ryc_smartobject OF ryc_attribute_value.
    FIND ryc_object_instance OF ryc_attribute_value.
    FIND container_smo WHERE container_smo.smartobject_obj = ryc_attribute_value.container_smartobject_obj.
    DISPLAY ryc_attribute_value.logical_value VIEW-AS FILL-IN ryc_smartobject.object_filename FORMAT "x(20)"
                  container_smo.object_filename   FORMAT "x(20)"
                  ryc_object_instance.layout_position.
END.
```
When you run this block of code, you see the three viewers in the oemaintwin test window shown in Figure 8–14. These are all disabled on initialization. (Note that the OrderLine viewer and the Order viewer have the same layout position because they are on different pages.)

![Figure 8–14: DisableOnInit properties for oemaintwin](image)

**SmartLink tables**

The object Repository also stores the representation of links between objects, which are paths of communication for events. As with the general notion of SmartObjects, this discussion of SmartLinks does not need to be taken as being entirely specific to support for SmartObjects. The notion of a path between two object procedure handles, which is used to identify where named events are published and subscribed to, could be applied to almost any implementation of an architecture in which ABL persistent procedures are used as application components.

Two general support tables identify what the possible link names and uses are.

**SmartLink type table**

The ryc_smartlink_type table defines the SmartLinks available for linking objects. Examples of standard links include Page, Container, Update, Commit, TableIO, etc. The main purpose of this table is to provide a valid list of links to choose from when building generic containers. Developers can define additional links using the user_defined_link field. The actual link name is cascaded down onto the ryc_smartlink table when this is not a user-defined link. The ryc_smartlink_type table contains the following fields:

- **link_name** — This CHARACTER field is the actual link name (excluding the source or target suffix). This name will always be cascaded down to the ryc_smartlink table when the user-defined link flag is set to NO, therefore avoiding having to always read this table to get the actual link name.

- **user_defined_link** — If this LOGICAL field is set to YES, this is a user-defined link and the link name specified here is for information purposes only, that is, this is a custom link. If this is set to NO, then this is a system link and the link name specified is cascaded down onto the ryc_smartlink table for performance reasons.

- **system_owned** — If this LOGICAL field is set to YES, this record can only be modified by users with a system-owned flag in their user profile definition.
Understanding the Repository Object Tables

**Supported link table**

The ryc_supported_link table defines the supported SmartLinks for the various types of SmartObjects, and it identifies whether the link can be a Source, Target, or both. User-defined links should not be set up in this table. The framework uses this table to return the valid links, both system and user-defined, when developers link objects on containers. It is merely a developer aid. Not all types of SmartObjects support links, in which case there will be no entries in this table for them. Because this table acts as a kind of cross-reference table between ryc_smartlink_type and ryc_smartlink, it holds, in addition to its own object ID field, the object IDs of the object type for which a link is supported, and the object ID of the smartlink_type record where the link is defined. The table has these other fields:

- **link_source** — If this LOGICAL field is set to YES, objects of this SmartObject type are capable of acting as the Source for the specified link.

- **link_target** — If this LOGICAL field is set to YES, objects of this SmartObject type are capable of acting as the Target for the specified link.

- **deactivated_link_on_hide** — If this LOGICAL field is set to YES, this link for this type of SmartObject is automatically deactivated when the object is hidden and activated again when the object is viewed.

**SmartLink table**

The ryc_smartlink table defines the actual SmartLinks between objects on a container and enables object communication. The link name is either user-defined or automatically copied from the ryc_smartlink_type for system-supported links. If the source object instance is not specified (that is, that object ID field equals zero), then the source is assumed to be the container. Likewise, if the target object instance is not specified, then the target is assumed to be the container. Example links are a TableIO link between a SmartDataBrowser and a SmartToolbar, a Record link between a SmartDataBrowser and a SmartDataViewer, etc. The table contains fields for the object IDs of the ryc_smartlink_type record for which this is an instance, and the container SmartObject in which this link instance occurs. The table has these other fields:

- **link_name** — This is the actual link name. The link name can be user-defined or automatically copied from the ryc_smartlink_type for system-supported links.

- **source_object_instance_obj** — This is the object ID of the object instance, which is the source end of the link.

- **target_object_instance_obj** — This is the object ID of the object instance, which is the target end of the link.
Figure 8–15 illustrates the relationships between the link tables and the SmartObject and object_instance tables.

Folder page tables

To support the definition and use of different layout combinations, there is a layout table to define the basic characteristics of each distinct type of page layout. Other tables define which objects in a container are on which pages. This section contains information about the following tables:

- Layout table.
- Page table.
- Page object table.

Layout table

The ryc_layout table defines the available page layouts for pages on SmartFolder™ windows, for example, one browser with one toolbar underneath, n viewers above each other, two side-by-side viewers, two side-by-side browsers, etc. It also defines the available frame layouts for objects on a frame, for example, one column, two columns, etc. The purpose of this table is to specify the program that is responsible for the layout when the window/frame is constructed or resized.
Most of the layout types defined in the layout table are in fact no longer actively used in building Progress Dynamics container windows. They are still used for windows in the framework tools themselves that have been built in earlier versions of the framework. The primary layout type now used is the Relative layout. However, the structure of the table and its fields remains the same. It has these fields:

- **layout_name** — This CHARACTER field is a unique name to identify the layout, for example, Relative.
- **layout_type** — This field is a three-character code to identify the type of layout, specifically the kinds of context in which it can be used. Currently, defined values for the layout type are PAG = Page Layout, FRA = Frame Object Layout, BTH = Both.
- **layout_narrative** — This CHARACTER field is a free-form description for the layout.
- **layout_filename** — This CHARACTER field value is the filename to run, including its relative path, in order to actually perform the layout of the objects on the page during initial construction and any later resize event. The Layout Manager procedure that uses this data is ry/prc/rylayouts.p, which is accessed from the dynamic SmartWindow procedure ry/uib/rydyncontw.w to do dynamic layout of container windows.
- **sample_image_filename** — This CHARACTER field contains the name and relative path of an image file that can be displayed illustrating the page layout, if one is available.
- **system_owned** — If this LOGICAL field is set to YES, this record can only be modified by users with a system-owned flag in their user profile.
- **layout_code** — This CHARACTER field is a suffix to add to internal procedures in the layout manager PLIP to identify the specific layout manager, for example, ‘01’ would run the procedure version resize01 for this layout. The Relative layout uses layout code ‘06’.

When containers of any kind are created to hold object instances, page and page_object records are created to define the contents of each page of a container.

**Page table**

The ryc_page table holds a record for every page of every dynamic container in the application. This table defines the actual pages in the container. All containers must have at least one page, which is Page 0, and it is always displayed. All objects on Page 0 are always displayed. If there are no other pages, then no tab folder is visualized. Example pages (identified by their page_label) could be Page 1, Page 2, Customer Details, etc. The table holds the object ID of the associated ryc_layout record, which in turn identifies the procedure to be used to realize the page at run time. The primary key of the ryc_page table also includes the container SmartObject object ID in addition to its own page object ID, even though the page object ID is unique in its own right, so that pages can be specifically associated with the container on which they appear. The ryc_page table also has these other fields:

- **page_sequence** — This INTEGER field is the actual page number and determines the sequence in which the pages are displayed. There must always be a Page 0, and any objects on Page 0 are always displayed. Page 0 does not appear on a tab folder. If there are no other pages, then no tab folder is visualized.
• **page_label** — This CHARACTER field is the actual label to display on the tab folder describing the contents of the page. The label can be entered with an ampersand (&) denoting the shortcut key to select the page, for example, &Details would enable the user to press **ALT+D** to select the page.

• **security_token** — This CHARACTER value defaults to the page label, without the ampersand, but can be different if required. The security token is used to automatically enable and disable folder pages according to user security permissions (via security allocation tokens).

• **enable_on_create** — If this LOGICAL field is set to YES, this folder page is enabled during an **Add** operation. If set to NO, then this folder page is disabled during an **Add** operation. This only affects the sensitivity of the folder tab for the page, not the objects contained on the page.

• **enable_on_modify** — If this LOGICAL field is set to YES, this folder page is enabled during a modify operation. If set to NO, then this folder page is disabled during a modify operation. This will only affect the sensitivity of the folder tab for the page, not the objects contained on the page.

• **enable_on_view** — If this LOGICAL field is set to YES, this folder page is enabled during a view operation. If it is set to NO, this folder page is disabled during a view operation. This only affects the sensitivity of the folder tab for the page, not the objects contained on the page.

### Page object table

The **ryc_page_object** table acts as a cross-reference table between pages and the objects on them. Remember that each **object_instance** defines a particular use of a SmartObject, so there is a one-to-one relationship between **ryc_object_instance** records and the **ryc_page_object** records that associate them with the pages of the container. Object ID fields relate this table to the **Page** table and the **object_instance** table; the container object ID is also stored in this table. The only other field in the table is **page_object_sequence**, which is an **INTEGER** field that identifies the sequence of objects on the page.
Understanding the Repository Object Tables

Figure 8–16 is an excerpt from the Repository database model and shows the relationships among the tables that support layouts and paging.

Customization tables

A full discussion of the Progress Dynamics support for customization is beyond the scope of this document, but because the customization tables affect the use of the other object tables, it is important to understand what the customization tables are and how they are used to modify objects at run time.

Customization support allows the developer to define types of end-user specifics that should affect the appearance or behavior of the application at run time. This might include changes based on the user ID, the client display platform, the task the user is doing, or anything else that can be categorized. Customization basically means that certain attribute values can be changed for an object depending on how it is used and who uses it.

There are three tables that provide support for customization:

- The **ryc_customization_type** table defines different categories of customization that are supported.
- The **ryc_customization_result** table stores specific result code values for a given customization type.
- The *rym_customization* table acts as a kind of cross-reference table that can be used to provide a more complex mapping between types and codes when no direct mapping is possible or practical.

Figure 8–17 is an excerpt from the database model and shows the three customization tables and how they relate to the SmartObject table.

**Figure 8–17: Customization tables**

### Customization type table

The *ryc_customization_type* table defines the different categories of customization that are supported. The Repository database comes with some types built in: *UIType*, *Language*, *LoginCompany*, *System*, *User*, and *UserCategory*. The type is used as a grouping mechanism for specific values or result codes that identify the end user’s environment. You can populate these with values meaningful to your application environment, and you can also define any additional customization types your application might need. The table includes a field where you can store the name of a procedure to call to determine the value for the current user for a type. This is effectively the result code that allows the framework to identify the right customizations to apply.

The table contains these fields:

- **customization_type_code** — This CHARACTER field is a unique code to identify the type, such as *UIType*.

- **customization_type_desc** — This CHARACTER field is a description of the code, and must also be unique within the table.

- **api_name** — This CHARACTER field holds the name of a function to invoke that will return the value for the type for the current session. This might be a UI type, a user ID, a Language name, or whatever is appropriate to the type. The function can, of course, do whatever work is necessary to identify the correct value to return based on the type. This return value must map either directly to one of the result codes in the *customization_result* table or to a value in the customization table that in turn can be mapped to a result code.
Customization result table

The `rcy_customization_result` table stores the specific result code values that are returned by the API function call for a given customization type. For example, the `UIType` customization type has several built-in result codes defined in the Repository:

- **APP** — AppServer
- **BTC** — Batch
- **CUI** — Character User Interface
- **GUI** — Graphical User Interface
- **WBC** — WebClient
- **WBS** — WebSpeed

You can define whatever result codes you need for different customization types required by your application. For example, the `Language` type could join to language result codes such as English and French. The `User` type could join to individual user IDs such as Anthony and Bruce. The `UserCategory` type could join to job types such as manager and engineer.

The `customization_result` table can be viewed as a list of valid values for a customization type. Result codes must be as distinctive as possible, because they must be unique within the `customization_result` table.

In addition to its own object ID field, the `customization_result` table holds the object ID of the associated `customization_type`. The `customization_result` table contains the following other fields:

- **customization_result_code** — This CHARACTER field is the result code to match against what is returned by the API call. The result code must be unique across all customization types.
- **customization_result_desc** — This CHARACTER field is a description of the result code. It must also be unique within this table.

Customization table

In many cases the `customization_result` table is sufficient to define all the information the application needs to identify which customizations should apply for a given session. In some cases, however, it is not possible to provide a simple, direct mapping between the value returned by the API call for a given customization type and the result codes stored in the `customization_result` table. For example, the customization type can be one that defines general categories or groups, such as `UserCategory`. It might be useful to define result codes that are categories such as manager or engineer, but these might not be directly represented anywhere in the application for the customization type API to return. Also, it is not practical to have to define result codes for every single user when in fact the customizations are defined not at the User level, but at the `UserCategory` level.
The `rym_customization` table allows you to define a mapping to solve this problem when such a mapping is needed. It is, in effect, a cross-reference table between `customization_type` and `customization_result`, to define a one-to-many relationship between the two. In addition to its own object ID, the table has object IDs to join it to both the `customization_type` table and the `customization_result` table.

It has just one other field called `customization_reference`. This CHARACTER field holds the cross-reference value that supports the mapping between type and result. For the `UserCategory` example, this field could contain individual user IDs as returned by the API function for the type. Each of these IDs can in turn be mapped to a result code record for the category. This would allow you to have a single result code called manager, and then have many `customization_reference` values that would map to that single `UserCategory`. When you define customizations, you define them against the manager result code. When you run the API function for the type, it returns a value that you look up in the customization table as a reference value. You can then link from there to the result code to identify the general result code for this category of user.

**Joining customizations to the SmartObject table**

The customizations by themselves do not affect the application. The key data relationship here is between the `customization_result` table and the `SmartObject` table. This is where the run time effects of the customizations are defined.

As we noted in the discussion on the SmartObject table, the unique key for that table (beyond its object ID) is not just the `object_filename`, but also the `customization_result_obj` field. For the standard object behavior, the `customization_result_obj` is 0. For customized behavior, it is joined to the `customization_result` table using this field. This means that there must be a distinct SmartObject record for each customization result code that applies to the object. If a viewer, for example, has been customized to have different behavior (such as different field positions or different fields enabled or displayed) for each of six different user categories and three different user interface types, such as GUI, CUI, and WBS, then there will be a total of ten `ryc_smartobject` records representing that one object: one for the default definition, six for the user categories, and three for the UI types.

Each of these `ryc_smartobject` records will have its own set of `attribute_value` records that define it. The SmartObject record with no `customization_result_obj` will define all the default attribute values. Each of the other SmartObject records will define only whatever specific attribute values have been modified for that customization. Thus, the SmartObject records with a `customization_result_obj` are incomplete and cannot be used by themselves to build the object at run time. Their values can only be applied to modify the base attributes defined by the default SmartObject record.

At run time, the Customization Manager determines the result codes that apply to the session for each customization type by running the functions defined in the `customization_type API_reference_name` field. This yields a delimited list that remains available for the remainder of the session. The Repository Manager then combines the various attributes joined to all of the applicable SmartObject records. It does this by using the result code list to identify which `customization_result` records to join to the SmartObject table to retrieve all the applicable `attribute_values`. If multiple customizations apply, a function called `getSessionResultCodes` in the Customization manager determines the priority of them. Those with the highest priority are applied last, so that they take precedence if there are conflicting values for other customization types.
For example, suppose that user George logs in to a Progress Dynamics session running on WebSpeed using the new browser-based Progress Dynamics UI. George is a data entry clerk. Three result codes apply to this session:

- **User**: George
- **UserCategory**: Clerk
- **UIType**: WBS

Suppose that this list represents the priority order of the customization types. (Customization type priority can in fact be defined and modified by session type.) When George runs a dynamic **Customer Maintenance** window as part of the application, a viewer inside the window has been customized in the following several different ways:

- George requested that the tab order of the fields be modified so that the data entry process for the **Customer Comments** field and the **Contact** field are more convenient for his data entry routine. He also requested that the **Comments** editor be made larger.
- George’s group manager defined a customization to the same viewer to disable the **Contact** field for clerks.
- The Web application customization chief determined that the **Comments** editor for the dynamic HTML interface should be made smaller to look better in that environment.

The result of all of this is that:

- The **Comments** field tab order is set as George requested it.
- The **Contact** field tab order is irrelevant because the field is disabled for George as a clerk.
- The size of the **Comments** editor is determined by the WBS definition because that takes precedence over George’s personal request that is defined at the user level.

Customizations can be defined only for attributes of SmartObject records, not directly for individual instances. However, you can define customizations at the level of a container window, which can be a way of accomplishing the same thing. In other words, the customizations are always done starting at the level of a SmartObject record. If that SmartObject record represents a container window, then it points to not only its attribute_value records, but also to object_instance records and their links and page records. Customizations can be done to the container by adding objects to the container or by modifying the attributes of objects inside the window for that window customization.
Figure 8–18 shows some of the records involved in defining these relationships.

Figure 8–18: Customization example

Figure 8–18 illustrates the following customization:

- George is a clerk, and customizations have been defined for the UserCategory Clerk, one of which is that the Customer viewer customerviewv has a height of 12 rather than its default height of 10.

- When George logs in, the Customization Manager assembles a list of all the appropriate result codes for his session. One of those is for UserCategory. The customization table defines a customization_reference for George for the UserCategory customization_type that maps to the result code Clerk in the customization_result table. As a result, the Customization Manager stored Clerk as the session result code for the UserCategory type.

- When the system goes to run a window using the customerviewv viewer, the Repository Manager must build a list of all the viewer’s attributes. To do this, it locates all the SmartObject records that apply for this session for the viewer. In this case, that means both the default SmartObject, with no customization_result code, and also the SmartObject with the customization_result code for Clerk. It applies all the standard attribute values for the default version of the SmartObject (including the MinHeight value of 10), and then applies the attribute values for the customization, one of which overrides the MinHeight and sets it to 12. These values are then sent to the Layout Manager to use to build the window.
Tools to support customization maintenance

A full description of the customization process is beyond the scope of this chapter, but there are some tools where you can define the customizations.

In the Progress Dynamics Development menu, there is a Customization Maintenance utility in the objects menu shown in Figure 8–19.

Figure 8–19: Customization Maintenance utility

Figure 8–20 provides a tree view showing the various levels of customization.

Figure 8–20: Levels of customization

In addition, the Container Builder allows you to specify a result code for an object or a window so that you can define attribute values specific to that object.

Using the Repository Manager

This section describes the following Repository Manager topics:

- Client cache.
- Repository Manager API.
- Retrieving related information for an object.
- How objects are instantiated using prepareInstance.
Client cache

As a Progress Dynamics run-time client or WebClient session runs, object descriptions are cached on the client in temp-tables. The data in these tables is then accessed by the drivers, such as the dynamic window procedure `rydyncontw.w` that realize the client portion of the application at run time.

This section summarizes the temp-tables that make up the client cache.

**Cache_Object table**

This temp-table contains information about master object records as well as contained instances. This table contains information about the static (physical) object required to instantiate a dynamic object, the logical object name and other data, such as the result code, run attribute, etc. There can only be one record in the cache for any given master object (and thus for its contained instances) at any given time. This table is (roughly) a combination of the information from the `ryc_smartobject` and `ryc_object_instance` Repository tables.

The `cache_Object` table is joined to records in the next four tables, `cache_ObjectPage`, `cache_ObjectLink`, `cache_ObjectPageInstance`, and `cache_ObjectUIEvent`, using the key field `tRecordIdentifier`.

The following code sample shows a slightly simplified definition of the `cache_Object` temp-table (without formats and indexes). All the cache temp-tables are defined in the include file `ry/app/ryobjretri.i`, as shown:

```plaintext
DEFINE TEMP-TABLE cache_Object
  FIELD tLogicalObjectName    AS CHARACTER /* Logical Object Name */
  FIELD tUserObj              AS DECIMAL   /* User object ID */
  FIELD tResultCode           AS CHARACTER /* set of result codes */
  FIELD tRunAttribute         AS CHARACTER /* Run Attribute */
  FIELD tLanguageObj          AS DECIMAL   /* Language object ID */
  FIELD tRecordIdentifier     AS DECIMAL   /* Instance Id key field */
  FIELD tContainerRecordIdentifier AS DECIMAL /* Container Record Id */
  FIELD tMasterRecordIdentifier AS DECIMAL /* Master Record Id */
  FIELD tClassName            AS CHARACTER /* Class Name */
  FIELD tClassTableName       AS CHARACTER /* Class Table Name */
  FIELD tClassBufferHandle    AS HANDLE    /* Class Attr Buffer Handle*/
  FIELD tContainerObjectName  AS CHARACTER /* Container Name */
  FIELD tInstanceIsAContainer AS LOGICAL   /* Is this a Container? */
  FIELD tObjectPathedFilename AS CHARACTER /* Pathed Filename */
  FIELD tObjectInstanceHandle AS HANDLE    /* Object Instance handle */
  FIELD tObjectInstanceObj    AS DECIMAL   /* Object Instance ObjectID*/
  FIELD tObjectInstanceName   AS CHARACTER /* Object Instance Name */
  FIELD tObjectInstanceDescription AS CHARACTER /* Instance Description */
  FIELD tDbAware              AS LOGICAL   /* Is Object DB Aware? */
  FIELD tLayoutPosition       AS CHARACTER /* Layout Position */
  FIELD tCustomSuperProcedure AS CHARACTER /* Super Procedure */
  FIELD tCustomSuperHandle    AS HANDLE    /* Super Proc. Handle */
  FIELD tDestroyCustomSuper   AS LOGICAL   /* Destroy Super on exit? */
  FIELD tInstanceOrder        AS INTEGER   /* Instance Order */
  FIELD tPageNumber           AS INTEGER   /* Page Number */
  FIELD tSmartObjectObj       AS DECIMAL   /* Smartobject object ID */
  FIELD tSdoSmartObjectObj    AS DECIMAL   /* SDO object ID if any */
  FIELD tSdoPathedFilename    AS CHARACTER /* SDO Pathed Filename */
  FIELD tInheritsFromClasses  AS CHARACTER /* Class list */
```
A few fields merit additional explanation:

- **tRecordIdentifier** — This field is the unique DECIMAL key for each object record in the temp-table.
- **tContainerRecordIdentifier** — This field holds the Record Identifier of the cache_Object record that acts as a container to the current object record.
- **tMasterRecordIdentifier** — This is the Record Identifier of the cache_Object record that is the master of the current instance record.
- **tClassBufferHandle** — This is the buffer handle that points to the class temp-table containing the attributes for this object.
- **tSdoSmartObjectObj** — This is the design-time SDO associated with the object, if any.
- **tInheritsFromClasses** — This field stores a list of the class names of all classes that this class inherits from.

### Cache_ObjectPage table

This temp-table contains information about pages within a container. It uses the information in the Repository database table ryc_page. This is the temp-table definition for this table:

```plaintext
DEFINE TEMP-TABLE cache_ObjectPage
   FIELD tRecordIdentifier AS DECIMAL /* Record Identifier key field */
   FIELD tPageNumber AS INTEGER /* Page Number */
   FIELD tPageLabel AS CHARACTER /* Page Label */
   FIELD tLayoutCode AS CHARACTER /* Layout Code */
   FIELD tPageInitialized AS LOGICAL /* Is the Page Initialized? */
   FIELD tPageObj AS DECIMAL /* Page object ID */
```

The tPageObj object ID is used for finding this record from the page object instance.

### Cache_ObjectLink table

The temp-table contains link information derived from this Repository table (ryc_smartlink):

```plaintext
DEFINE TEMP-TABLE cache_ObjectLink
   FIELD tRecordIdentifier AS DECIMAL /* record Identifier key field */
   FIELD tSourceObjectInstanceObj AS DECIMAL /* Link Source object ID */
   FIELD tTargetObjectInstanceObj AS DECIMAL /* Link Target object ID */
   FIELD tLinkName AS CHARACTER /* Link Name */
   FIELD tLinkCreated AS LOGICAL /* Has the link been created? */
```
Cache_ObjectPageInstance table

This temp-table contains information about object instances on a given page derived from the Repository table ryc_page_object. This is the definition of the table:

```
DEFINE TEMP-TABLE cache_ObjectPageInstance
FIELD tRecordIdentifier         AS DECIMAL   /* Record Identifier key */
FIELD tPageNumber               AS INTEGER   /* Page Number */
FIELD tObjectInstanceObj        AS DECIMAL   /* Object Instance object ID */
FIELD tObjectInstanceHandle     AS HANDLE    /* Object Instance Handle */
FIELD tObjectInstanceName       AS CHARACTER /* Object Instance Name */
FIELD tObjectTypeCode           AS CHARACTER /* Class Code */
FIELD tLayoutPosition           AS CHARACTER /* Layout Position */
```

Cache_ObjectUIEvent table

This temp-table contains information about UI events derived from ryc_ui_event:

```
DEFINE TEMP-TABLE cache_ObjectUIEvent
FIELD tClassName                     AS CHARACTER /* Class Name */
FIELD tRecordIdentifier              AS DECIMAL
FIELD tEventName                     LIKE ryc_ui_event.event_name
FIELD tActionType                    LIKE ryc_ui_event.action_type
FIELD tActionTarget                  LIKE ryc_ui_event.action_target
FIELD tEventAction                   LIKE ryc_ui_event.event_action
FIELD tEventParameter                LIKE ryc_ui_event.event_parameter
FIELD tEventDisabled                 LIKE ryc_ui_event.event_disabled
```

The fields are described below:

- **tClassName** — For the master class, this field is set equal to buildDenormalisedAttributes temporarily, and then the actual class name.
- **tRecordIdentifier** — This is the Record Identifier for the table within the class name; the value 0 is used for the master.

Cache_<classname> tables

There is a dynamic temp-table containing attribute information for each defined class or object type in the Repository, with the name class_<classname>. Each of these temp-tables has a field for each attribute defined for the class, whose initial value is the default attribute value defined for the attribute for that class, using the Attribute Value Maintenance and Object Type Maintenance utilities. These temp-tables are dynamic because they are defined at run time based on the set of attributes associated with each class. When you use the framework utilities to add attributes to a class and give them an initial value for the class, it is this information that the framework uses to create the temp-table for each class at run time. In this way attributes can be added to the classes in the framework without the need to define them anywhere in source code or to recompile any procedures in order for them to become a part of all the dynamic objects in that class.

See the “Using the Profile Manager” section on page 6–41 for an example of how you can define new attributes and associate them with object types.
ttClass table

This temp-table stores the names of all the classes (object types) and their associated temp-table names, along with the handles to the default buffers of the temp-tables that have been created to store each class's default attributes. As described above, a separate dynamic temp-table is defined for each class, containing a separate field for every attribute in the class, plus some extra control fields. The table for each class is called cache_ + the class name, for example: cache_dynview.

The ttClass table is updated in the function createClassCacheRecord in the Repository Manager, which is called from the createClassCache procedure, which caches the attribute values for an object type.

Record identifiers

Every cache_object record has a unique key, called tRecordIdentifier. This DECIMAL value is used as a foreign key to join the object record to other tables. This value is also stored at runtime in the object property called InstanceID.

The tContainerRecordIdentifier field in the cache_object table contains the Record Identifier of the cache_object record that represents the container object on which the current cache_object is an instance. This is zero when the cache_object represents a master object.

The tMasterRecordIdentifier field in the cache_object table is the Record Identifier of the cache_object representing the master object of this cache_object record. This value is the same as the Record Identifier if this cache record represents a master object.

Repository Manager API

These are a few of the most useful methods in the Repository Manager API. The principal body of code for the Repository Manager is in the include file ry/app/ryrepmngrp.i.

cacheObjectOnClient

The function cacheObjectOnClient checks if the requested object exists in the client-side cache. If the requested object is not in the cache, it is retrieved from the Repository and placed in the cache. This function returns a logical value signifying the success of the operation.

The cacheObjectOnClient() function ensures that all the requested objects, their contained instances, their associated master objects, and all related information is placed in the cache.

When cacheObjectOnClient is called, it first checks to see if the requested object is cached. If it is, then the relevant record is positioned to and nothing further happens. If the record does not exist in the cache, then the function must retrieve the data from the Repository and place it into the cache. If the Repository database is connected, then cacheObjectOnClient runs bufferFetchObject. This performs the actual retrieval and puts the objects into a cache using putObjectInCache.

If the Repository database is not connected locally, then the function runs doServerRetrieval. This procedure runs serverFetchObject on the AppServer. serverFetchObject runs bufferFetchObject and puts the information into temp-tables, which are then returned to the caller. doServerRetrieval then calls putObjectInCache, which ensures that the objects are in the cache. The last thing that cacheObjectOnClient does is to do a FIND on the requested record in the cache so that it is AVAILABLE to the caller.
The cacheObjectOnClient function takes the following INPUT parameters:

- **pcLogicalObjectName** — This CHARACTER parameter is the name of the object to cache. If this is a container, then all of its contained objects are cached as well so that the entire container is ready to be created on the client.

- **pcResultCode** — If the client is using a customization, then this CHARACTER parameter is the result code for that customization. If this parameter is the Unknown value (?) or blank, then the function retrieves the SessionResultCodes session property to establish any default result codes.

- **pcRunAttribute** — If the object requires a Progress Dynamics Run attribute as an input value, this CHARACTER parameter holds that value. If this argument is the Unknown value (?), the function retrieves the RunAttribute session property to see if that defines a default run attribute.

- **plDesignMode** — This LOGICAL parameter is TRUE if the caller is running in design mode rather than run time. In design mode, the client cache is always cleared on each call so that the developer is assured of having the latest changes made to the Repository data by the development tools.

The methods bufferFetchObject, serverFetchObject, doServerRetrieval, and putObjectInCache should be considered private to the Repository Manager. You should not normally run these directly.

**Functions used to retrieve cache table buffer handles**

All operations that must use the cache information use the one set of temp-tables where all cached data resides. There is a set of functions to return the buffer handles of the tables in the cache. These are:

- getCacheObjectBuffer
- getCachePageBuffer
- getCachePageInstanceBuffer
- getCacheLinkBuffer
- getCacheUIEventBuffer
- getCacheClassBuffer

With the except of getCacheObjectBuffer and getCacheClassBuffer, these functions take no INPUT parameters. Each returns the HANDLE of the requested buffer.

getCacheObjectBuffer() takes as an input parameter an optional object instance ID and returns the buffer handle of the cache_Object table. If the input value is a non-null instance ID, the function finds the relevant record in the cache_Object table before returning the buffer handle. This is important because it means that, with an instance ID, you can get back an AVAILABLE buffer handle to the record in the cache. This saves having to do FIND-FIRST() to position to the desired record yourself.
getCacheClassBuffer() takes as an input parameter the name of a class (the object type code) and returns the buffer handle of the ttClass temp-table. With this you can read class attributes without starting from a particular object. If you pass in a single, valid class name, the buffer that it returns points to the ttClass record that corresponds to that class. If the class name passed in to the function does not yet exist in the ttClass table portion of the client cache, the function retrieves it from the Repository. You can also pass in either an asterisk (*) to represent all classes or a comma-separated list of class names, and all the valid classes in the list are retrieved. However, in this case no ttClass record is positioned to at the end of the function, since there is no single right record to find.

Using the API to retrieve class attributes and values

To be able to access the attributes for a class, you must first get the handle of the attribute buffer. The ttClass buffer handle that getCacheClassBuffer returns is the handle of the record for the class in the ttClass table, not the handle of the attribute table for the class. The buffer handle of the attribute temp-table is stored in the classBufferHandle field of the ttClass record.

This code sample shows how you can retrieve all of the attributes and their default values for a given class, for example, the dynamic SDO or DynSDO. The first call is to the function getCacheClassBuffer in the global handle of the Repository Manager. This ensures that the DynSDO class is in the client cache, and returns the handle of the ttClass buffer. If the data is not already there, it is retrieved from the server. The function does a FIND of the correct record in the cache when it is done, as shown:

``` Smalltalk
DEFINE VARIABLE httClassBuffer     AS HANDLE NO-UNDO.
DEFINE VARIABLE hClassAttributeBuffer AS HANDLE NO-UNDO.
DEFINE VARIABLE iFieldCount         AS INTEGER   NO-UNDO.
DEFINE VARIABLE cAttributeName      AS CHARACTER NO-UNDO.
DEFINE VARIABLE cClassAttributeValue AS CHARACTER NO-UNDO.
ASSIGN httClassBuffer = DYNAMIC-FUNCTION("getCacheClassBuffer":U IN gshRepositoryManager, INPUT "DynSDO").

DO iFieldCount = 1 TO hClassAttributeBuffer:NUM-FIELDS:
   ASSIGN cAttributeName = hClassAttributeBuffer:BUFFER-FIELD(iFieldCount):NAME
   cClassAttributeValue = hClassAttributeBuffer:BUFFER-FIELD(iFieldCount):INITIAL.
   /* Process the attribute values */
END.
```

The classBufferHandle field holds the handle of the buffer handle for the specific dynamic class table for the class’s attributes, in this case cache_DynSDO, as shown:

``` Smalltalk
ASSIGN hClassAttributeBuffer =
   httClassBuffer:BUFFER-FIELD("classBufferHandle"):BUFFER-VALUE.
```

The variable hClassAttributeBuffer now points to the cache_DynSDO buffer. Now you can get all the attribute values for the class. The INITIAL value of the field represents the default value of each attribute for this class, as shown:
One important thing to keep in mind is that with only one set of buffers to access everything in the cache, you must be aware that records can go out of scope. So, if you find a cache_object record and then run an object based on it, chances are that by the time the run statement returns to your procedure, the cache_object record you were positioned to is no longer current. This is mainly because the prepareInstance function (described later) is run for every SmartObject, and it interacts with the cache_object records. It is very easy to reposition the cache_object record back to the desired record. If you pass `getCacheObjectBuffer()` a valid Record Identifier (instance ID), it repositions the cache_object buffer to the correct record. Alternatively, you can use your own set of defined buffers to give you additional buffers whose records won’t be changed out from under you.

**Accessing Repository data without the cache**

If you would rather not use the cache, as would be the case in application design tools, then when making calls from a development tool, you can call `serverFetchObject` directly. This procedure returns the requested information in table form. This means that you are guaranteed to get the data as it is in the Repository at any given moment. However, what you lose is the caching. A full description of `serverFetchObject` and other calls that access the data more directly is beyond the scope of this chapter. You should study the code in `ry/app/ryrepmngrp.i` if you are building a development tool that you feel must use these internal calls. Be aware that `serverFetchObject`, for example, has a complex calling sequence that includes a large number of TABLE-HANDLES, each one for a separate temp-table for attribute data related to a particular class of object.

Do not use the cache if you want to use the information for design purposes in a tool. Running `cacheObjectOnClient()` returns the object in unaggregated form: each result code is separated. If you want to design with aggregated data, then you would need to run this procedure or clear the cache with every call.

You can also use the `serverFetchObject` procedure when you want to retrieve Repository data for external use, for example, in a tool that does some form of analysis or reporting of the Repository data.

**Retrieving related information for an object**

This section outlines how you retrieve various kinds of information in the cache that is related to an object, and which completes the definition of the object.

**Retrieving the instance ID for an object**

Before finding any related information, you must have the instance ID (the tRecordIdentifier field value) of the record whose associated information you require. There are several ways of doing this.

If the object is running, you can retrieve the instance ID as an object property using the ADM property include file syntax. In this example, the object handle is in the variable `hObject` and the Record Identifier is retrieved into the variable `dInstanceID`:

```bash
{get InstanceId dInstanceId hObject}
```
Or you can use the equivalent function call, as shown:

```plaintext
dInstanceID = DYNAMIC-FUNCTION('getInstanceID' IN hObject).
```

Alternatively, the object that you request using cacheObjectOnClient() is available immediately after the call to that function. You can then use a statement such as the following to return the buffer handle to the cache_object temp-table, which will also be positioned to the requested record:

```plaintext
ASSIGN hObjectBuffer =
    DYNAMIC-FUNCTION("getCacheObjectBuffer":U IN gshRepositoryManager, INPUT ?).
```

After finding the cache_object buffer, do a FIND based on your own criteria to position to the relevant record. Once you have found an available hObjectBuffer record, you can populate the dInstanceId variable using a statement such as this:

```plaintext
ASSIGN dInstanceId =
    hObjectBuffer:BUFFER-FIELD("tRecordIdentifier":U):BUFFER-VALUE.
```

Getting the instance ID is the first step to getting all the other related information out of the cache.

**Retrieving other object information**

To get Page, Page instance, link, and UI event information for a particular object, first retrieve the buffer handle for the relevant cache buffer, using one of the functions getCachePageBuffer, getCachePageInstanceBuffer, getCacheLinkBuffer, or getCacheUIEventBuffer. In this code example, hBuffer is the buffer handle retrieved using one of those function calls. Create a dynamic query on that table, with a WHERE clause such as this:

```plaintext
hQuery:QUERY-PREPARE(" FOR EACH ":U + hBuffer " WHERE ":U + hBuffer:NAME + ".tRecordIdentifier = " + QUOTER(dRecordIdentifier)  ).
```

**Retrieving attribute values for an object**

To retrieve attribute values, you first must obtain the instance ID (the tRecordIdentifier field value) from the cache_object record. Remember that the correct cache_object record is AVAILABLE after a call to cacheObjectOnClient(). Otherwise, if you have the object’s instance ID, you can make a call to getCacheObjectIdBuffer(), passing in the instance ID. This ensures that the correct record is available to you. The tClassBufferHandle field contains the buffer handle of the record that contains the attributes for the object.
Using a statement such as the following, you can retrieve the attributes for the specific object. Note the use of the recently introduced dynamic FIND-FIRST method on a buffer handle, which allows you to position the buffer to a record using a dynamic WHERE clause, as shown:

```sql
hAttributeBuffer:FIND-FIRST(" WHERE ":U 
  + hAttributeBuffer:NAME + ".tRecordIdentifier = " + QUOTER(dRecordIdentifier) 
  ).
```

You can now retrieve the values for the relevant field, as shown in the code sample earlier in this section.

**Retrieving an object’s contained instances**

There are two primary ways of getting all the contained instances for a container object. You can query all cache_Object records where either:

- The tContainerRecordIdentifier equals the instance ID of the container master object.
- The tContainerObjectName equals the logical object name of the container object. This second method requires you to also include in your query the user, language, result code, and run attribute, as well as checking that the object instance object ID is zero.

The first alternative is simpler and requires less programming work since all that is needed is the instance ID, which is readily available. The other information required to use the second alternative requires various calls and possibly further calculation.

**How attributes are stored**

Each class has its own attribute temp-table, with a field for each attribute in the class. This includes all attributes inherited by the class from its parent classes. The initial value of each attribute field is the initial or default value of the attribute for that class. The temp-table is created dynamically by buildClassCache() and is called cache_<ClassName>. These tables and their buffer handles are then cached in the ttClass temp-table.

There are also a couple of fields which the cache_<ClassName> table uses internally:

- **tRecordIdentifier** — This field contains the Record or instance ID of the cache_Object record to which the attributes belong.
- **tWhereStored** — This field contains an INTEGER indicating at what level the attribute is stored (class, master, or instance) and whether customization has been applied to the attribute. The getWhereStoredLevel1 function returns a character description of this value for a given field within an attribute buffer.

**How objects are instantiated using prepareInstance**

This section outlines the steps necessary to bring a container window or other container object into being at run time using the cached Repository information. If you want to understand more about exactly how containers are created, you can study the relevant code in the ADM2 support procedure `src/adm2/container.p`, as well as the dynamic window procedure `ry/uib/rydyncontw.w`. 

8–49
When an object is launched, whether it is by launchContainer, constructObject, or just from the editor, a Repository Manager function called prepareInstance is called from the main block of the base ADM property include file smrtprop.i. This is just about the earliest that anything can run in the ADM world, and the call must be as early as possible so that the ADMProps temp-table, where all of each object’s attributes are held, is built as soon as possible.

The prepareInstance function attempts to determine the logical name of the object being launched, since this is what is used to retrieve the objects from the Repository. It does this by calling a function called getCurrentLogicalName in the procedure that launched the object being run. This function is defined in the Session Manager (which contains launchContainer, the primary starting point for objects run from the menu), the dynamic container procedure rydyncontw.w, the dynamic viewer rydynviewv.w, and the dynamic TreeView rydyntreew.w.

The value returned by getCurrentLogicalName can be in one of two forms (errors and blanks excepted):

- The actual value of the object’s logical name, equivalent to the Repository field ryc_smartobject.object_filename.
- A value in the form of InstanceId=<value>.

If there is a single valid object name, rather than the form InstanceId=*, the relevant data is retrieved from either the cache or the Repository, using cacheObjectOnClient. Once this data is returned, the ADMProps temp-table is constructed based on the object’s attribute buffer.

The InstanceID ADM attribute is set at this point. Each object that is run will have a unique InstanceID.

The reason for the two different forms of the return value of getCurrentLogicalName is that when you are instantiating a master object (which would be the container of other objects), the function returns the actual logical object name that you want to retrieve. When you want to retrieve object instances within a container, the function returns the InstanceId= form. This is because there might be many records with the contained instance’s logical object name. If a toolbar is placed on many windows, for example, there will be one record for the master and one for each object instance. By contrast, there can only be one record with a particular instance ID (tRecordIdentifier).

Consider a window called window1. It contains an SDO called fullo1 and a browser called browser1. If you launch window1 from a menu, launchContainer sets the CurrentLogicalName value to window1 before running the dynamic container object (the procedure rydyncontw.w). When rydyncontw.w runs, it picks up the logical object name and passes that into the function cacheObjectOnClient, which then retrieves into the cache the five sets of object records that make up the window:

- window1 itself (the master object).
- fullo1 (the master and instance of fullo1 on window1).
- browser1 (the master and instance of fullo1 on window1).

Two standard ADM2 support procedures in the container class have been extended for Progress Dynamics to create dynamic containers from cached Repository data as opposed to simply running static procedure objects, as would be the case with a standard Version 9 ADM2 application. These are createobjects and constructObject.
As window1 is created, the ADM container startup code runs createobjects. This procedure has the responsibility of creating the objects that are to appear on window1. createobjects retrieves the InstanceID property of window1 and then makes sure that the correct cache_object record is available, by calling getCacheObjectBuffer and passing in the InstanceID. This InstanceID is used to build a query to loop through all of the contained instances (...WHERE tContainerRecordIdentifier = dInstanceID).

The framework then runs constructObject to construct browser1 and fulllo1. The code must make sure that the correct set of attributes is used for the instance of each object on window1, so it sets the CurrentLogicalName to Instanceid= since this is already available.
Index

A
Action rules
alternate image 3–35
enable 3–35
functions 3–41
hide 3–35
menu/toolbar 3–35
properties 3–39
syntax 3–39
Action target 1–15
Action type 1–14
Actions, enabled or disabled 3–35
Addquerywhere function 5–31
ADM2 8–4
code 8–7
properties 8–14
support procedures 8–50
Alternate image rule 3–35, 3–37
API
manager 6–18
multiTranslation call 6–66
Repository Manager 8–44
universal 6–39
AppBuilder
dynamic launcher 6–5
property sheet 1–7
Applying security restrictions 6–69
AppServer
managers stateless connection 6–3
Architecture
Progress Dynamics 8–4
Progress Dynamics managers 6–14
askQuestion 6–59
procedure 6–58
assignPage property 5–38
Attribute definitions 8–14
Attribute level 8–49
Attribute maintenance window 3–20
Attribute tables 8–14, 8–16
relationships 8–15
Attribute value level 3–19
Attribute values 8–19
class level 8–25, 8–26
instance level 8–28
levels 8–20
object 8–48
object instance level 8–23
object master level 8–22
table 8–19
attribute_group_name field 8–16
attribute_group_narrative field 8–16
attribute_group_obj field 8–16
attribute_label field 8–16
Attributes
  adding 6–46
  COLUMN-MOVABLE 6–63
  control 3–20
  defining 6–45
  hierarchy 3–21
  minHeight 3–9, 3–10
  object type level 8–22
  resize vertical 3–10
  value
    changing 3–21

Auto commit property 5–38

B

Base procedure 1–5

BrowseColumnsMovable property 6–44

Browser
  attributes 1–41, 6–63
  custom super procedure 1–37, 6–49
  new properties 6–44
  profile data 6–63
  properties 1–38

Browser handle 5–7

Buffer handle 5–7, 8–42

Business logic 1–4, 1–28
  procedure 1–35, 8–8
  running 1–33

Buttons
  disabling and hiding 3–24

C

Cache
  clearing 7–24
  client 8–41
  procedures, server-side 7–22

Cache APIs 4–12

Cache key 4–13

Cache types 4–2

Cache, shared 4–5

Cache_object table 8–41

CacheDuration property 4–5

cacheObjectOnClient function 8–44

Caching
  application data 4–1
  combos and 4–8
  field-based 4–7
  lookups and 4–7
  SDO-based 4–5

canNavigate function 3–36, 3–41

Changing
  attribute value 3–21
  profile/preferences 6–41

Character properties 5–3

Check value 3–31

checkProfileDataExists 6–51

Class
  attribute value 3–21
  behavior 1–6
  inheritance 8–42
  level 8–26

class_smartobject_obj field 8–8

Clear client cache procedure 7–24

clearCache function 4–15

Client
  code 1–3, 7–6
  logic 1–28
    functions 1–41
  logic API 1–41
  logic support 1–18
  minimizing calls 1–3
  proxy 7–4
  super procedure code 1–4

Collect changes event 5–37

Column attribute functions 5–9

COLUMN-MOVABLE attribute 6–63

Configuration file manager 6–5, 6–34, 6–39

Connection manager 6–9, 6–36, 6–39

Connections
  between records 8–13
Container
   handle property 5–7
   type 5–4
container_object field 8–10

Containers
   pages defined 8–32

Context
   database table 6–21
   management 6–21
   table 6–22

Control
   attribute 3–20
   object type 3–20

Control window
   manager type 6–6
   service type 6–7
   session type 6–6

createBrowsePopupMenu 6–54
createSharedBuffer function 4–15

Creating
   dynamic objects 5–11
   manager type 7–9

Cross-reference table 8–33
Cross-reference value 8–37

Custom SmartLinks 5–26

Custom SmartObject object field 8–11

Custom super procedures 1–5, 3–25
   browser 1–37, 6–49
   code 1–8
   defining logic 1–9
   registering 3–26
   viewer 3–26

Customer Maintenance
   viewer 3–6

Customization
   categories 8–35
   maintenance tools 8–40
   result table 8–36
   table 8–36
   tables 8–34

Customization manager 6–13, 8–37

Customization result object 8–11

Customization type table 8–35

Customizing function and property rules 3–41

D

Data
   browser profile 6–63
   caching 7–19

Data available procedure 3–28, 5–18
Data handle property 5–38

Data links
   disabling 3–13

Data object functions 5–10

Data visualization property 3–41
data_type field 8–16

DataField objects 8–3

DataModified property 3–40

DB-AWARE setting 7–3

DB-REQUIRED setting 7–4

Defining attributes 6–45

Defining properties 6–23

Defining super procedure 1–7

deletePage procedure 5–39

Deployment type 8–7, 8–11

Derived value 8–18

destroyObject procedure 5–21

destroySharedBuffer function 4–15

Disable
   actions 3–24
   buttons and menu items 3–24
   fields 5–18
   object 5–17
   security 8–7

Disable access 8–10

DisableActions function
   when not to use 3–35

Disabled
   actions 3–30

disableFields procedure 3–29

DisplayedFields property 1–38, 5–5

DisplayObjects procedure 5–18

Distributed applications 1–3
<table>
<thead>
<tr>
<th>Topic</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distributed environment performance issues</td>
<td>1–4</td>
</tr>
<tr>
<td>Dynamic container starting</td>
<td>6–25</td>
</tr>
<tr>
<td>Dynamic launcher</td>
<td>6–5</td>
</tr>
<tr>
<td>Dynamic object</td>
<td>5–11, 8–7</td>
</tr>
<tr>
<td>generator</td>
<td>1–12</td>
</tr>
<tr>
<td>Dynamic property sheet</td>
<td>3–17</td>
</tr>
<tr>
<td>Dynamic viewer testing</td>
<td>1–18</td>
</tr>
<tr>
<td>Dynamics Manager</td>
<td>7–1</td>
</tr>
<tr>
<td>startup</td>
<td>7–4</td>
</tr>
<tr>
<td>Field attributes functions</td>
<td>5–8</td>
</tr>
<tr>
<td>Field edit data information manager</td>
<td>7–16, 7–15</td>
</tr>
<tr>
<td>Field values functions</td>
<td>5–8</td>
</tr>
<tr>
<td>FieldHandles property</td>
<td>1–38</td>
</tr>
<tr>
<td>Fields enabled enabling/disabling handles</td>
<td>5–4, 3–29, 5–5</td>
</tr>
<tr>
<td>findCacheItem function</td>
<td>4–14</td>
</tr>
<tr>
<td>Folder adding to test window</td>
<td>3–4</td>
</tr>
<tr>
<td>Folder page tables</td>
<td>8–31</td>
</tr>
<tr>
<td>Foreign fields property</td>
<td>5–29, 3–7</td>
</tr>
<tr>
<td>Function reference</td>
<td>1–26, 1–27</td>
</tr>
<tr>
<td>Fetch procedures</td>
<td>5–20</td>
</tr>
<tr>
<td>fetchDataFromCache function</td>
<td>4–14</td>
</tr>
<tr>
<td><strong>G</strong></td>
<td>General manager 6–12, 6–74</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------</td>
</tr>
<tr>
<td></td>
<td>get function 8–17</td>
</tr>
<tr>
<td></td>
<td>getEntityDescription procedure 6–20</td>
</tr>
<tr>
<td></td>
<td>getManagerHandle function 6–35</td>
</tr>
<tr>
<td></td>
<td>getPhysicalSessionType function 6–38</td>
</tr>
<tr>
<td></td>
<td>getProfileData 6–52</td>
</tr>
<tr>
<td></td>
<td>getPropertyList function 6–23</td>
</tr>
<tr>
<td></td>
<td>getTranslation 6–66</td>
</tr>
<tr>
<td></td>
<td>getUserProperty function 5–42</td>
</tr>
<tr>
<td>Group assign link 3–13</td>
<td></td>
</tr>
<tr>
<td>gsc_object_type table 8–7</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>H</strong></th>
<th>Handles 5–7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>basic managers 6–35</td>
</tr>
<tr>
<td></td>
<td>procedure 6–14</td>
</tr>
<tr>
<td></td>
<td>static 6–35</td>
</tr>
<tr>
<td>hasActiveAudit function 3–41</td>
<td></td>
</tr>
<tr>
<td>hasActiveComment function 3–41</td>
<td></td>
</tr>
<tr>
<td>Hide</td>
<td>action rule 3–35</td>
</tr>
<tr>
<td>HideObject procedure 5–18</td>
<td></td>
</tr>
<tr>
<td>HidePage procedure 5–39</td>
<td></td>
</tr>
<tr>
<td>Hiding buttons and menu items 3–24</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>I</strong></th>
<th>IN TARGET-PROCEDURE 1–21</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Include files 1–33, 8–14</td>
</tr>
<tr>
<td></td>
<td>Index information 5–10</td>
</tr>
<tr>
<td></td>
<td>Init page procedure 5–39</td>
</tr>
<tr>
<td></td>
<td>Initialization properties 5–22</td>
</tr>
<tr>
<td></td>
<td>InitializeObject procedure 3–25, 5–17, 6–50</td>
</tr>
<tr>
<td></td>
<td>Instance attribute value 3–21</td>
</tr>
<tr>
<td></td>
<td>browser attributes 1–41</td>
</tr>
<tr>
<td></td>
<td>description 8–12</td>
</tr>
<tr>
<td></td>
<td>name 8–12</td>
</tr>
<tr>
<td></td>
<td>objects 3–20</td>
</tr>
<tr>
<td></td>
<td>property list function 5–41</td>
</tr>
<tr>
<td></td>
<td>Instance ID 8–49</td>
</tr>
<tr>
<td></td>
<td>retrieving 8–47</td>
</tr>
<tr>
<td></td>
<td>Instance level attribute value 8–28</td>
</tr>
<tr>
<td></td>
<td>setting properties 3–16</td>
</tr>
<tr>
<td></td>
<td>Instances contained 8–49</td>
</tr>
<tr>
<td></td>
<td>Integrating applications 6–27</td>
</tr>
<tr>
<td></td>
<td>isICFRunning function 6–34</td>
</tr>
<tr>
<td></td>
<td>Item link 3–38</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>J</strong></th>
<th>Joins</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>customization SmartObject table 8–37</td>
</tr>
<tr>
<td></td>
<td>SmartObject table 8–37</td>
</tr>
<tr>
<td></td>
<td>unique 8–5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>K</strong></th>
<th>Keys</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cache object record 8–44</td>
</tr>
<tr>
<td></td>
<td>unique 8–5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>L</strong></th>
<th>launchContainer procedure 6–5, 6–24</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>launchExternalProcedure 6–32</td>
</tr>
<tr>
<td></td>
<td>launchFolderWindow procedure 5–22</td>
</tr>
<tr>
<td></td>
<td>launchProcedure 6–24</td>
</tr>
<tr>
<td></td>
<td>layout_position field 8–12</td>
</tr>
<tr>
<td></td>
<td>layout_supported field 8–7</td>
</tr>
<tr>
<td></td>
<td>Level constant 3–21</td>
</tr>
<tr>
<td></td>
<td>Link editor 3–11</td>
</tr>
<tr>
<td></td>
<td>modifying activation 3–11</td>
</tr>
<tr>
<td></td>
<td>repository 8–42</td>
</tr>
<tr>
<td></td>
<td>Linked object values 3–27</td>
</tr>
<tr>
<td></td>
<td>LinkHandles function 5–27</td>
</tr>
</tbody>
</table>
Index

LinkProperty function 5–27

Links
  addLink 5–24
  container 5–25
  data 3–13
  groupAssign 3–13
  item 3–38
  management 5–23
  object 3–3
  properties 5–28
  SmartObject 5–24
  source/target 8–30
  support methods 5–25

Localization manager 6–64

Logic
  business 1–28
  client-side API 1–41
    defined in super procedures 1–9

Logical service maintenance window 6–7

LogicalObjectName 5–3

Lookup type 3–22

lookup_value field 8–19

M

Maintenance windows
  logical/physical service 6–8

Manager
  access from viewers 7–30
  accessing from SDO 7–27
  API 6–3
  architecture 6–4, 6–14
  client 6–15
  client/server 6–3
  code 6–15
    server 6–19
  creating field edit 7–15
  defining 7–18
  handles 6–14
  new 7–5
  overview 6–3
  Progress Dynamics 7–1
  registering 7–26
  server 6–15
  structuring on server 6–16
  templates 7–3
  testing 7–32

Manager type
  control window 6–6
  creating 7–9
  defining 6–6
  editing 6–36
  maintenance 7–9

Mapping
  customization 8–37

Master
  attribute value 3–21
  browser attributes 1–41
  objects 3–20

Master level
  property setting 3–15

Menu items
  disabling and hiding 3–24

Message
  control 7–29
  table 6–56

Messages
  defining and using 6–56

Methods
  modifyNewRecord 5–36
  startup/shutdown 5–21

MinHeight attribute 3–9

MinWidth attribute 3–10

ModifyDisabledActions procedure 3–26

Modifying objects 8–34

ModifyList property 5–42

ModifyNewRecord method 5–36

multiTranslation API call 6–66

N

Naming conventions 1–17

NewRecord property 3–41

NO-PROXY setting 7–3

O

Object diagram 8–6

Object generator
  modifying 1–12

Object IDs 8–5

Object instance 8–28
  level 8–23
  table 8–12

Object master level 8–22
Object record 8–41
   key 8–42

Object type
   code 8–7
   control 3–20
   description 8–7
   level 8–22
   maintenance window 3–23
   table 8–6

ObjectEnabled property 5–4

ObjectMode property 3–41

Objects 8–1
   adding to test window 3–5
   class 8–6
   DataField 8–3
   description 8–9
   dynamic generation 8–4
   filename 8–9
   handles 5–7
   hierarchy 8–6
   identification 3–33
   in repository 8–5
   instantiated with prepareInstance 8–49
   linked 3–27
   modifying 8–34
   names 5–3
   order maintenance 3–7
   relationships with super procedures 1–21
   static/dynamic 1–8, 8–7
   static/logical 8–9
   types 5–3
   widget 8–3

Order maintenance objects 3–7

Overrides
   parameters 3–27

P

Page object table 8–33

Page table 8–32

Pages
   defined 8–32
   enable/disable 8–32

Paging
   methods/properties 5–38
   properties 5–40

Partitioning
   internal/external 6–19

pcContainerMode 6–26

pcInstanceAttributes 6–26

pcLogicalName 6–26

pcObjectFileName 6–25

pcPhysicalName 6–25

pcProcedureType 6–27

pcRunAttribute 6–26

Performance issues 1–4

Persistent procedures 6–24, 8–29

phObjectProcedure 6–27

phParentProcedure 6–26

phParentWindow 6–26

phProcedureHandle 6–27

Physical object name 5–3

Physical service maintenance window 6–8

Physical types 6–38

physical_smartobject_obj field 8–11

PLIP
   running 1–28, 1–33

plOnceOnly 6–26

Pop-up menu
   creating 6–54
   defining event procedures 6–56
   disabling 6–44
   menu drop 6–63
   translating labels 6–64

Prepare query function 5–20

prepareInstance function 8–49

PRO*Tools 1–22

Procedure handle 5–5

Procedures
   addLink 5–24
   adm-create-object 5–12
   askQuestion 6–58
   assignPageProperty 5–38
   cacheFieldEdits 7–19
   clearClientCache 7–24
   collectChanges 5–37
   constructObject 5–14
   dataAvailable 3–28, 5–19
   deletePage 5–39
   destroyObject 5–21
   disableFields 3–29
   displayFields 5–21
   displayObject 5–18
   enableFields 3–29, 7–30
Procedures (cont.)
  enableFields/disableFields 5–18
  enableObject/disableObject 5–17
  eventMenuItemChoose 6–56
  exitObject 5–21
  fetch 5–20
  fieldEditData 7–26
  fieldEditValidate 7–28
  getEntityDescription 6–20
  hidePage 5–39
  icfstart.p 7–14
  initializeObject 3–25, 3–32, 5–17, 6–50, 7–27
  initPages 5–39
  launchContainer 6–25
  launchProcedure 6–24
  modifyDisabledActions 3–26
  modifyListProperty 5–42
  plipSetup 7–15
  removeLink 5–26
  reset 3–30
  rowDisplay 1–39
  rowObjectValidate 7–31
  selectPage 5–40
  sendRows 5–20
  setProfileData 6–60
  showMessages 6–61
  viewObject/hideObject 5–18
  viewPage 5–39

Product module
  object 8–8

Profile
  changing 6–41
  creating types and codes 6–42
  data 6–51
  defining types 6–9
  manager 6–41, 6–51

Progress Dynamics Architecture 8–4

Properties
  action rules 3–39
  browser
    new 6–44
  data visualization 3–41
  DataModified 3–40
  defining 6–23
  DisabledActions 3–24
  disableOnInit 5–22
  editable 3–40
  FolderWindowToLaunch 5–23
  foreign fields 3–7
  ForeignFields 3–7
  Hidden Actions 3–24
  managing 5–41
  NewRecord 3–41
  objectInitialized 5–22
  ObjectMode 3–41
  OnInit 5–22
  page 5–40

query position 3–36
QueryPosition 3–39
RecordState 3–40
RowObjectState 3–40
setting at instance level 3–16
setting at master level 3–15
setUser 5–41
tableIOType 3–24
visual 3–14

Property
  action rule 3–39
  management 6–23
  setting values 6–23
  values 6–23
    client/server 6–24

Property include files 8–14

PropertyType function 5–41

Prototype generator (ProtoGen) 1–22

PUBLISH statement 1–21
  parameters 3–27
  redirect 3–34

Q

Queries
  custom 5–29
  filter 5–29
  handle 5–7
  management 5–29
  refresh 5–34

Query
  properties 5–38

Query selection
  assign/remove 5–31

QueryObject property 5–4

QueryPosition property 3–36, 3–39

QueryRowObject property 1–38, 5–7

R

Record identifiers 8–42, 8–44, 8–49

RecordState property 3–40

Referential integrity manager 6–13

Refreshing database query 5–34

registerCacheItem function 4–13

Remove links procedures 5–26
Repository
  adding tables 7–16
  database 6–21
  design manager 6–11
  maintenance tool 1–14
  manager 6–11
  Object IDs 8–5
  object maintenance tool 3–15
  standard tables 7–16
  storing translated text 6–64
Repository manager 8–37, 8–40
  API 8–44
Request manager 6–12
  required_db_list field 8–10
Reset procedures 3–30
Resize
  horizontal 3–9, 5–15
  modifying attributes 3–9
  vertical 3–9, 5–15
Result codes 8–35
Retrieving object information 8–47
Row object
  properties 5–38
  table properties 5–38
rowDisplay procedure 1–39
RowObjectState property 3–40
Rules
  action
    defined for menu/toolbar 3–35
RUN SUPER statement
  when not to use 3–34
run_when option 8–11

S
Schema
  triggers 6–13
Scoping variables 3–33
Section editor 7–20
Security 8–8
  adding check 6–70
  disable/enable 8–7
  restrictions 6–69
  Security manager 6–11, 6–69
  security_smartobject_obj field 8–11
Select page procedure 5–40
Server
  calls to manager 7–21
  code 7–6
Service
  connecting 6–40
  disconnecting 6–40
  interacting 6–41
  registering 6–40
Service type manager
  registering 6–40
Session
  defining types 6–6
  manager 6–5, 6–21
  type 7–11
  properties 6–8
  type and parameter 6–37
  set function 8–17
Set query functions 5–30
setOpen query 5–30
setProfileData procedure 6–60
setPropertyList
  function 6–23
Setting properties 3–17
setUser property 5–41
Shared cache 4–5
showMessages procedure 6–61
Shutdown
  methods 5–21
  unsaved changes message 8–10
Signature function 5–43
SmartDataObjects 8–42
  accessing Manager 7–27
SmartLink tables 8–29, 8–30
SmartLink type table 8–29
SmartLinks 3–3
  supported 8–30
SmartObject table 8–8, 8–13
joining customizations 8–37
SmartObjects 8–7
initialization 5–17
super procedures 1–5, 1–6
Startup
command
session type 7–14
Dynamics 7–4
methods 5–21
Statements
PUBLISH
redirect 3–34
RUN SUPER
do not use 3–34
Static handle 6–35
Static object 8–7
static_object field 8–9
Storing attributes 8–49
SUBSCRIBE statement 1–21
Super procedures
client code 1–4
creating 1–11
custom 1–5, 3–25
registering 3–26
defining 1–7
principles 1–19, 1–20, 1–21, 1–24
relationships with objects 1–21
scoping variables 3–33
SmartObjects 1–6
Support functions 1–39, 6–12
Synching instances 4–11
System
support 6–12
system_owned field 8–10, 8–12
TARGET-PROCEDURE 1–26, 1–27
template_smartobject field 8–10
Templates
Manager 7–3
Temp-table 6–3
cache_object page 8–42
cache_ObjectLink 8–42
client cache 8–41
object instances 8–43
property values 6–23
translation 6–66
using 6–66
UI events 8–43
Text
translation 6–64
The 4–5
tokenSecurityCheck 6–73
Toolbar
adding to test window 3–4
Tools
customization 8–40
translatePhrase function 6–65
Translation
control 6–64
temp-table 6–66
text 6–64
text strings 6–64
Types
physical 6–38
User interface
events 1–14
generation by Web browser 6–13
manager 6–13
naming conventions 1–17
supporting procedures 1–17
testing 1–18
viewer 1–14
Web-based 6–4
User interface events 1–11
User profile
types and codes 6–42
Index

V
Value check 3–31
View page procedure 5–39
Viewer
  customer maintenance 3–6
  property sheet 3–18
ViewObject procedure 5–18
Visual properties
  modifying 3–14

W
Web browser 6–4
WHERE clause 5–29
  customize with add query 5–31
Widget 1–9
Widget functions 1–39
Widget objects 8–3
Writing code
  basic principles 1–28