

Oracle's PeopleTools PeopleBook

PeopleTools 8.52: Application Engine

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Contents

Preface

Oracle's PeopleSoft Application Engine Preface	xi
Application Engine	xi
PeopleBooks and the PeopleSoft Online Library	xi

Chapter 1

Getting Started With Application Engine	1
PeopleSoft Enterprise Application Engine Overview	1
PeopleSoft Enterprise Application Engine Implementation	2

Chapter 2

Understanding Application Engine	5
Application Engine Fundamentals	5
Meta-SQL	5
Application Engine Program Elements	6
Sections	6
Steps	6
Actions	6
State Records	8
Application Engine Program Types	8
Application Engine Program Types	8
Daemon Program Type	9
Transform Program Type	10

Chapter 3

Creating Application Engine Programs	11
Viewing Application Engine Programs	11
Using Definition View	12
Using Program Flow View	13
Switching Between Definition and Program Flow Views	15

Using the Refresh Option	16
Filtering View Contents	16
Printing Program and Flow Definitions	19
Creating, Opening, and Renaming Programs	19
Creating New Programs	20
Opening Existing Programs	20
Renaming Programs	20
Copying or Moving Program Elements	21
Testing Application Engine Programs	21
Setting Program Properties	23
Accessing Properties	23
Setting General Properties	23
Setting State Record Properties	23
Specifying Temporary Tables	25
Setting Advanced Properties	26
Adding Sections	28
Understanding Sections	28
Inserting Sections	29
Locating Sections	29
Setting Section Properties	30
Adding Steps	31
Inserting Steps	31
Setting Up Step Properties	32
Specifying Actions	33
Understanding Actions	34
Inserting Actions	35
Setting Action Properties	35
Specifying SQL Actions	37
Specifying Do Actions	38
Specifying PeopleCode Actions	40
Specifying Call Section Actions	41
Specifying Log Message Actions	42
Specifying XSLT Actions	43

Chapter 4

Developing Efficient Programs	45
Using State Records	45
Understanding State Records	45
Sharing State Records	46
Choosing a Record Type for State Records	47
Setting Commits	47
Reusing Statements	48

Using the Bulk Insert Feature	50
Using Set Processing	50
Understanding Set Processing	51
Using Set Processing Effectively	51
Avoiding Row-by-Row Processing	53
Using Set Processing Examples	54

Chapter 5

Using Meta-SQL and PeopleCode	59
Understanding Application Engine Meta-SQL	59
Using PeopleCode in Application Engine Programs	60
Understanding PeopleCode and Application Engine Programs	60
Deciding When to Use PeopleCode	62
Considering the Program Environment	63
Accessing State Records with PeopleCode	64
Using If/Then Logic	65
Using PeopleCode in Loops	65
Using the ASection Class	66
Making Synchronous Online Calls to Application Engine Programs	66
Using the File Class	67
Calling COBOL Modules	67
Calling PeopleTools APIs	70
Using the CommitWork Function	70
Calling WINWORD Mail Merge	71
Using PeopleCode Examples	71
Including Dynamic SQL	73
Using Application Engine Meta-SQL	74
%Abs	74
%AeProgram	74
%AeSection	75
%AeStep	75
%AsOfDate	75
%AsOfDateOvr	75
%BINARYSORT	75
%Bind	76
%Cast	78
%ClearCursor	78
%COALESCE	79
%Comma	79
%Concat	80
%CurrentDateIn	80
%CurrentDateOut	80

%CurrentDateTimeIn	81
%CurrentDateTimeOut	81
%CurrentTimeIn	81
%CurrentTimeOut	81
%DateAdd	82
%DateDiff	82
%DateIn	82
%DateNull	83
%DateOut	83
%DatePart	83
%DateTimeDiff	83
%DateTimeIn	84
%DateTimeNull	84
%DateTimeOut	84
%DecDiv	85
%DecMult	85
%Delete	85
%DTTM	86
%EffDtCheck	86
%Execute	86
%ExecuteEdits	87
%FirstRows	89
%GetProgText	89
%Insert	90
%InsertSelect	90
%InsertSelectWithLongs	91
%InsertValues	91
%JobInstance	91
%Join	92
%KeyEqual	92
%KeyEqualNoEffDt	92
%LeftParen	93
%Like	93
%LikeExact	93
%List	93
%ListBind	96
%ListEqual	97
%Mod	98
%Next and %Previous	98
%NoUpperCase	99
%NumToChar	99
%OldKeyEqual	100
%ProcessInstance	100
%ResolveMetaSQL	100
%ReturnCode	102

%RightParen	103
%Round	103
%RoundCurrency	103
%RunControl	104
%Select	104
%SelectAll	105
%SelectByKey	105
%SelectByKeyEffDt	106
%SelectDistinct	106
%SelectInit	106
%Space	107
%SQL	107
%SQLRows	108
%Substring	109
%Table	109
%Test	110
%TextIn	110
%TimeAdd	110
%TimeIn	110
%TimeNull	111
%TimeOut	111
%TimePart	111
%TrimSubstr	112
%Truncate	112
%TruncateTable	112
%Update	113
%UpdatePairs	114
%UpdateStats	114
%Upper	118
Chapter 6	
Managing Application Engine Programs	119
Running Application Engine Programs	119
Understanding Program Run Options	119
Creating Process Definitions	120
Listing Process Definition Parameters	121
Starting Programs with the Application Engine Process Request Page	122
Using PeopleCode to Invoke Application Engine Programs	124
Using the Command Line to Invoke Application Engine Programs	125
Debugging Application Engine Programs	128
Enabling the Application Engine Debugger	128
Setting Debugging Options	129

Restarting Application Engine Programs	133
Understanding Restart	133
Determining When to Use Restart	134
Controlling Abnormal Terminations	136
Restarting Application Engine Programs	136
Starting Application Engine Programs from the Beginning	137
Enabling and Disabling Restart	138
Caching the Application Engine Server	138
Freeing Locked Temporary Tables	139

Chapter 7

Calling Application Engine Programs from COBOL	141
Adding Copybooks to COBOL Programs	141
Assigning Copybook Values	143
Handling COBOL Errors	147

Chapter 8

Tracing Application Engine Programs	149
Understanding Tracing Application Engine Programs	149
Understanding Trace Results	149
Trace File Sections	150
Step Traces	153
SQL Traces	153
Statement Timings Traces	153
Database Optimizer Traces	155
Enabling Application Engine Tracing	158
Setting Command Line Options	158
Setting Parameters in Server Configuration Files	159
Setting Options in PeopleSoft Configuration Manager	159
Locating Trace Files	160

Chapter 9

Using Temporary Tables	163
Understanding Temporary Tables	163
Creating Temporary Table Instances	165
Understanding Temporary Table Instances	165
Defining Temporary Tables	166
Setting the Number of Temporary Table Instances	166

Building Table Instances	168
Managing Temporary Table Instances	168
Understanding Temporary Table Instance Numbers	169
Assigning Temporary Tables to Programs	169
Adjusting Meta-SQL	172
Making External Calls	174
Viewing Temporary Table Usage	176
Viewing Temporary Table Usage by Record	176
Viewing Temporary Table Settings by Program	177
Viewing Online Instance Usage	178
Resolving the Temporary Table Usage Warning Message	178
Index	181

Oracle's PeopleSoft Application Engine Preface

This PeopleBook discusses PeopleSoft Application Engine.

Application Engine

Application Engine is designed to help you develop, test, and run background SQL processing programs. This PeopleBook explains the concepts and advantages of Application Engine, how to develop Application Engine programs in Application Designer, how to run and debug programs, and the use of the special tools to maintain your programs.

The "About These PeopleBooks Preface" contains general product line information, such as related documentation, common page elements, and typographical conventions.

Note. *DB2 UDB for OS/390 and z/OS* is the official IBM name for the database management system (DBMS). In the current PeopleTools release, Oracle no longer supports the OS/390 operating system, only z/OS, its replacement. For the sake of brevity, this PeopleBook sometimes refers to DB2 UDB for OS/390 and z/OS as *DB2 z/OS*, and it sometimes refers to DB2 UDB for Linux, UNIX, and Windows as *DB2 UNIX/NT*.

PeopleBooks and the PeopleSoft Online Library

A companion PeopleBook called *PeopleBooks and the PeopleSoft Online Library* contains general information, including:

- Understanding the PeopleSoft online library and related documentation.
- How to send PeopleSoft documentation comments and suggestions to Oracle.
- How to access hosted PeopleBooks, downloadable HTML PeopleBooks, and downloadable PDF PeopleBooks as well as documentation updates.
- Understanding PeopleBook structure.
- Typographical conventions and visual cues used in PeopleBooks.
- ISO country codes and currency codes.
- PeopleBooks that are common across multiple applications.
- Common elements used in PeopleBooks.
- Navigating the PeopleBooks interface and searching the PeopleSoft online library.
- Displaying and printing screen shots and graphics in PeopleBooks.

- How to manage the locally installed PeopleSoft online library, including web site folders.
- Understanding documentation integration and how to integrate customized documentation into the library.
- Application abbreviations found in application fields.

You can find *PeopleBooks and the PeopleSoft Online Library* in the online PeopleBooks Library for your PeopleTools release.

Chapter 1

Getting Started With Application Engine

This chapter provides an overview of PeopleSoft Enterprise Application Engine and discusses:

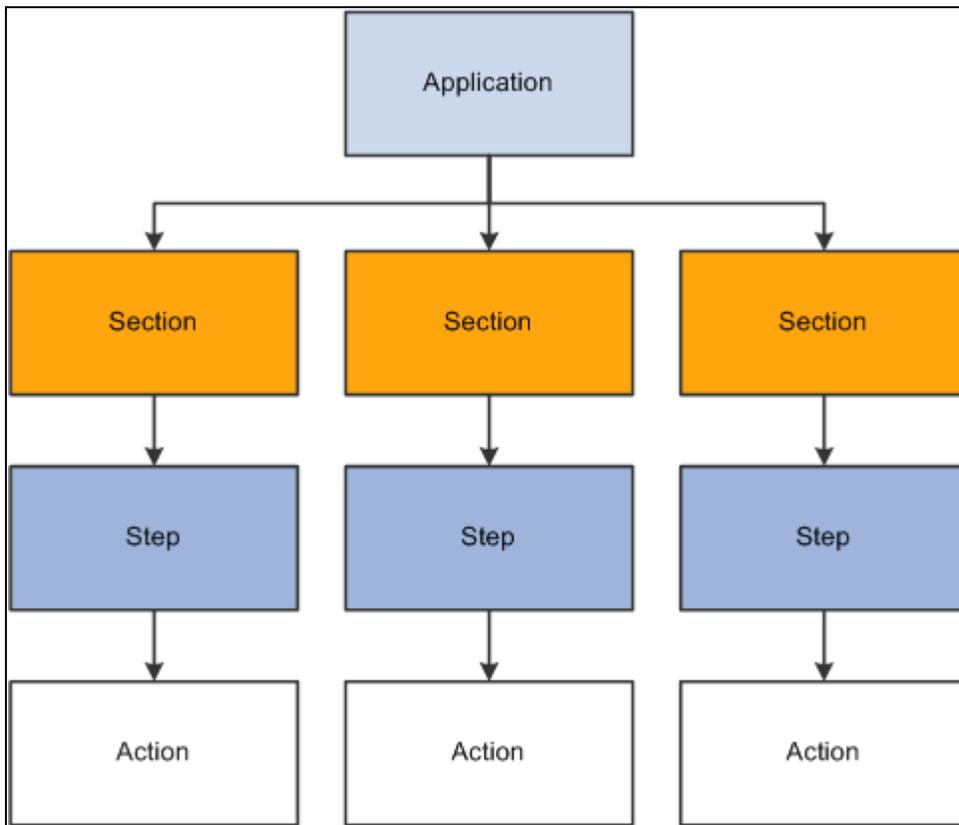
- Application Engine implementation.
- Other sources of information.

PeopleSoft Enterprise Application Engine Overview

Application Engine is a PeopleTool designed to help you develop background SQL processing programs. This tool is intended to be used by developers with knowledge of SQL, SQL tools, and PeopleTools.

Application Engine offers an alternative to writing COBOL or SQR programs for background SQL processing. While Application Engine does not generate, parse, or understand SQL, it does execute SQL that you provide.

This diagram shows the program structure of Application Engine:



Application Engine program structure

PeopleSoft Enterprise Application Engine Implementation

This section provides information to consider before you begin to use Application Engine.

Implementation of Application Engine can be divided into these activities:

- Set up properties.
- Specify actions.
- Create temporary table instances.
- Set up debugging options.
- Enable Application Engine tracing.

Setting Up Properties

To set up Application Engine properties, perform these steps:

Step	Reference
1. Set up program properties.	See Chapter 3, "Creating Application Engine Programs," Setting Program Properties, page 23.
2. Set up section properties.	See Chapter 3, "Creating Application Engine Programs," Setting Section Properties, page 30.
3. Set up step properties.	See Chapter 3, "Creating Application Engine Programs," Setting Up Step Properties, page 32.
4. Set up action properties.	See Chapter 3, "Creating Application Engine Programs," Setting Action Properties, page 35.

Specifying Actions

To modify action properties, perform these steps:

Step	Reference
1. Specify SQL actions.	See Chapter 3, "Creating Application Engine Programs," Specifying SQL Actions, page 37.
2. Specify Do actions.	See Chapter 3, "Creating Application Engine Programs," Specifying Do Actions, page 38.
3. Specify PeopleCode actions.	See Chapter 3, "Creating Application Engine Programs," Specifying PeopleCode Actions, page 40.
4. Specify Call Section actions.	See Chapter 3, "Creating Application Engine Programs," Specifying Call Section Actions, page 41.
5. Specify Log Message actions.	See Chapter 3, "Creating Application Engine Programs," Specifying Log Message Actions, page 42.

Creating Temporary Table Instances

To set up temporary tables to improve performance, perform these steps:

Step	Reference
1. Define temporary tables.	See Chapter 9, "Using Temporary Tables," Defining Temporary Tables, page 166.
2. Set up the number of temporary table instances.	See Chapter 9, "Using Temporary Tables," Setting the Number of Temporary Table Instances, page 166.
3. Build table instances.	See Chapter 9, "Using Temporary Tables," Building Table Instances, page 168.

Setting Up Debugging Options

To set up debugging options for Application Engine programs, perform these steps:

Step	Reference
1. Enable the Application Engine debugger.	See Chapter 6, "Managing Application Engine Programs," Enabling the Application Engine Debugger, page 128.
2. Set up debugging options.	See Chapter 6, "Managing Application Engine Programs," Setting Debugging Options, page 129.

Enabling Application Engine Tracing

To trace Application Engine programs, perform these steps:

Step	Reference
1. Set command line options.	See Chapter 8, "Tracing Application Engine Programs," Setting Command Line Options, page 158.
2. Set parameters in server configuration files.	See Chapter 8, "Tracing Application Engine Programs," Setting Parameters in Server Configuration Files, page 159
3. Set options in Configuration Manager.	See Chapter 8, "Tracing Application Engine Programs," Setting Options in PeopleSoft Configuration Manager, page 159.

Other Sources of Information

In addition to implementation considerations presented in this chapter, take advantage of all PeopleSoft sources of information, including the installation guides, release notes, and PeopleBooks.

See Also

["Oracle's PeopleSoft Application Engine Preface," page xi](#)

PeopleTools 8.52: Getting Started with PeopleTools

Chapter 2

Understanding Application Engine

You use Application Engine to develop batch or online programs that perform high-volume background processing against your data.

This chapter discusses:

- Application Engine fundamentals.
- Meta-Structured Query Language (SQL).
- Application Engine program elements.
- Application Engine program types.

Application Engine Fundamentals

Application Engine comprises two distinct components—a designer where you define your batch program and the runtime environment where you run and monitor your program.

In Application Engine, a *program* is a set of SQL statements, PeopleCode, and program control actions that enable looping and conditional logic. A program is defined in Application Designer to perform a business process. You can use Application Engine for straight, row-by-row processing, but the most efficient Application Engine programs are written to perform set-based processing.

Application Engine does not generate SQL or PeopleCode. It runs the SQL and PeopleCode that you include in an Application Engine action as part of your program.

Application Engine is designed for batch processing where you have data that must be processed without user intervention—for example, calculating salaries in payroll processing (although not printing the checks). Another example might be converting money from one currency to another.

Meta-SQL

You can write SQL within Application Engine, or you can copy SQL statements into Application Engine from any SQL utility with few, if any, changes. This capability enables you to write and fine tune SQL statements before you try to incorporate them into an Application Engine program.

Database platforms can have different syntax rules, especially in regard to date, time, and other numeric calculations. Generally, you can work around syntax differences using PeopleSoft meta-SQL, which Application Engine supports. Meta-SQL is a set of predefined terms (meta-strings) designed to replace relational database management system (RDBMS)-specific SQL syntax with a common syntax.

In addition, PeopleSoft meta-SQL enables you to dynamically generate portions of SQL code. For example, to join two tables based on their common keys, use the following meta-string:

```
%Join(COMMON_KEYS, PSAESECTDEFN ABC, PSAESTEPDEFN XYZ )
```

At runtime, the function would be expanded into the following:

```
ABC.AE_APPLID = XYZ.AE_APPLID  
AND ABC.AE_SECTION = XYZ.AE_SECTION  
AND ABC.DBTYPE = XYZ.DBTYPE  
AND ABC.EFFDT = XYZ.EFFDT
```

Application Engine Program Elements

An Application Engine program comprises the set of processes to carry out a given task. It is made up of these key elements:

- Sections
- Steps
- Actions
- State records

Sections

Sections include one or more steps and are equivalent to a COBOL paragraph or an SQR procedure. All Application Engine programs must contain at least one section entitled *MAIN*.

A section is a set of ordered steps that is executed as part of a program. You can call sections (and other programs) from steps within other sections.

A program must contain at least one section. Running the program always starts with the section defined as *MAIN*.

Steps

Steps are the smallest unit of work that can be committed within a program. Although you can use a step to execute a PeopleCode command or log a message, typically you use a step to execute a SQL statement or to call another section. The SQL or PeopleCode that a step executes are the actions within the step.

When a section is called, its steps execute sequentially. Every program begins by running the first step of the required section called *MAIN* and ends after the last step in the last section completes successfully.

Actions

You can specify multiple types of actions for inclusion within a step. Multiple actions are commonly associated with a single step.

Do Actions

Do actions contain a SQL **Select** statement designed to return results on which subsequent actions depend. For instance, if a **Select** statement returns no rows, then subsequent actions may not need to execute. A Do action is equivalent to a COBOL **Perform** statement and has similar constructs.

The four types of Do actions are:

- Do While
- Do When
- Do Select
- Do Until

SQL

Most SQL actions contain a single SQL statement. These actions can perform the following types of SQL statements:

- **Update**
- **Delete**
- **Insert**
- **Select**

A SQL action differs from a Do action, which also contain SQL, in that the SQL action does not control the flow of the program.

PeopleCode

You can include PeopleCode in a PeopleCode action. Application Engine PeopleCode provides an excellent way to build dynamic SQL, perform simple if/else edits, set defaults, and other operations that do not require a trip to the database. It also enables you to reference and change active Application Engine state records.

Most importantly, PeopleCode provides access to the PeopleSoft integration technologies, such as PeopleSoft Integration Broker, Component Interfaces, Business Interlinks, and file processing.

Log Message

You use a Log Message action to write a message to the message log based on a condition in your program. This functionality gives your program multi-language capability. The system stores the message generically as a message set, message number, and parameter values. When a user views the messages using the Application Engine Message Log page, the system retrieves the appropriate message string from the message catalog based on the user's language preference.

Call Section

You can also insert an action that calls another section. The called section can be in the same program as the calling section, or it can be in an external program. This capability enables you to chunk your program into more maintainable, reusable pieces. If a section already exists in one program, then rather than copying it into another program you can just call it.

Note. Application Engine supports up to 99 levels of nested Call Section actions. For example, the first called section can call a second, which can call a third, and so on up to 99 calls.

State Records

A state record is a PeopleSoft record that must be created and maintained by the Application Engine developer. This record defines the fields a program uses to pass values from one action to another. Think of the fields of the Application Engine state record as the working storage for your Application Engine program.

An Application Engine state record can be either a physical record or a work record, and you can associate any number of state records with a program. You must key physical state records by process instance.

Application Engine Program Types

This section discusses:

- Application Engine program types.
- Daemon program type.
- Transform program type.

Application Engine Program Types

Application Engine has five types of programs. You specify the type in the Program Properties dialog box for your program definition. The types are:

- Standard, which is a normal entry-point program.
- Upgrade Only, which is used in PeopleSoft upgrade utilities.
- Import Only, which is used by PeopleSoft import utilities.
- Daemon Only, a type of program used as a daemon process.
- Transform Only, a program type used to support Extensible Stylesheet Language Transformations (XSLT).

Daemon Program Type

Application Engine provides a daemon process, called PSDAEMON, that runs continuously when PeopleSoft Process Scheduler is running and is intended for recurring jobs. It polls the system, checking for certain conditions to occur. A predefined set of conditions is an *event*. When the conditions are true, PSDAEMON schedules a process to handle the event.

PSDAEMON supports limited tracing because it runs indefinitely. Specifically, it only allows Application Engine tracing at the step and SQL levels, in addition to the standard PeopleSoft SQL and PeopleCode tracing. It does not support other options, such as Timings and DB Optimizer tracing.

You activate PSDAEMON in PeopleSoft Process Scheduler or from the command line.

Note. One PSDAEMON process can run for each row in the PS_SERVERDEFN table. The PS_SERVERDEFN.DAEMONENABLED field must be set to 1.

Starting PSDAEMON from the Command Line

The command line syntax is:

```
psdaemon [-CT database_type] [-CD database_name] =>
  [-CO userID] [-CP password] -R server_name
```

Use the `-R` option to query PS_SERVERDEFN, obtaining the daemon group, sleep time, and recycle count (terminate after *N* iterations). *Server_name* is the key value for PS_SERVERDEFN. You do not need to pass ProcessInstance (`-I`) or AE Program ID (`-AI`).

Starting a Daemon Program from PeopleSoft Process Scheduler

Before starting a daemon Application Engine program, you must add the program to the Daemon Group page in PeopleSoft Process Scheduler.

To add a daemon program:

1. Select PeopleTools, Process Scheduler, Daemon Group.
2. Select the Add New Value page.
3. Enter a daemon procedure group name and click Add.
4. On the Daemon Group page, add the appropriate programs to the program name list.

Restarting the AEDAEMONMGR Program

AEDAEMONMGR is a restartable Application Engine program that commits after each daemon procedure. When PSDAEMON executes, it determines whether it must restart AEDAEMONMGR following an abnormal end to a program.

If a restart is not required, PSDAEMON assigns a new process instance and runs AEDAEMONMGR from the beginning. Because of this design, PeopleSoft Process Scheduler does not have to determine whether PSDAEMON exited due to an error or because it had reached the recycle count.

AEDAEMONMGR uses the Daemon Group page value to get related daemon procedures from PS_DAEMONGROUP in order, and then it initiates each procedure. After all procedures have been executed, AEDAEMONMGR logs a sleep message and returns control to PSDAEMON. The sleep time is used only to log an informational message at the end of each cycle, for example, "Sleeping for N minutes...." It also logs a message at the beginning of each cycle so that an administrator can monitor the runtime and sleep-time of a specific PSDAEMON process.

If an error occurs in AEDAEMONMGR, if the recycle count has been reached, or if PSSERVERSTAT.DAEMONACTION = '1' (indicating that PeopleSoft Process Scheduler is idle), then PSDAEMON exits. Otherwise, it sleeps for the requested number of minutes and then calls AEDAEMONMGR again.

Using PSDAEMON to Start Parallel Processing

Within a daemon group, programs are invoked sequentially and one program does not execute until the previous program has completed. The programs contained in a daemon group should be quick programs that scan information to find events. When an event is discovered, the daemon program can use the ProcessRequest class to invoke programs that are not of the daemon type. These *non-daemon type* Application Engine programs can execute in parallel. For that reason, do not include application-specific processing in a PSDAEMON type program.

See Also

PeopleTools 8.52: PeopleSoft Process Scheduler, "Defining PeopleSoft Process Scheduler Support Information," Defining Process Type Definitions

Transform Program Type

Transform Only type programs enable different systems to communicate with one another by transforming messages into appropriate formats. When you specify an Application Engine program as a Transform Only program, you must specify actions of type XSLT or PeopleCode. You can use transform programs to:

- Apply a transformation to a message to make its structure comply with the requirements of the target system.
- Perform a data translation on a message so its data is represented according to the conventions of the target system.
- Determine whether to pass a message through to its target by filtering it based on its content.

See Also

PeopleTools 8.52: PeopleSoft Integration Broker, "Applying Filtering, Transformation and Translation," Developing Transform Programs Using PeopleSoft Application Engine

Chapter 3

Creating Application Engine Programs

An Application Engine program includes a logically ordered set of sections, steps, and actions. An executable program must contain at least one section, called MAIN, used to identify the starting point of the program. Also, it should contain at least one step, and each step should contain at least one action.

This chapter discusses how to:

- View Application Engine programs.
- Filter view contents.
- Print program and flow definitions.
- Create, open, and rename programs.
- Copy or move program elements.
- Test Application Engine programs.
- Set program properties.
- Add sections.
- Add steps.
- Specify actions.

Viewing Application Engine Programs

This section discusses how to:

- Use Definition view.
- Use Program Flow view.
- Switch between Definition and Program Flow views.
- Use the Refresh option.

Using Definition View

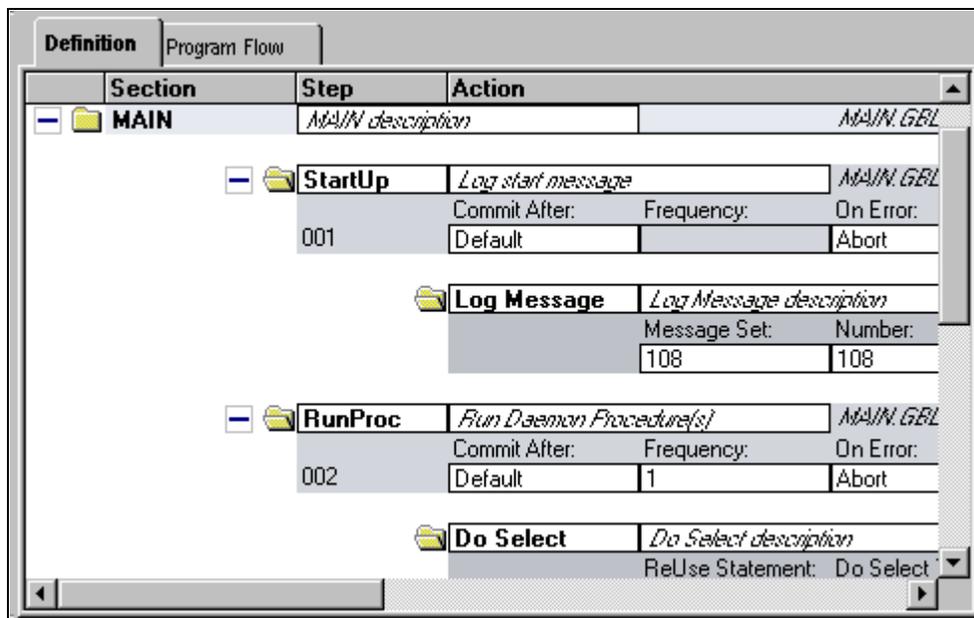
You use Definition view to create definitions within a defined hierarchical structure, in which nodes represent the definitions. A node is the visual representation of a section, step, or action that you can select, collapse, modify, and so on.

The sections that appear in Definition view do not necessarily appear in the order that they execute. To see the actual order in which the sections execute, switch to Program Flow view.

In addition to using a mouse, you can navigate in this view using the following keyboard combinations:

- Press Ctrl+Home to scroll to the top of the program definition and select the first node.
- Press Ctrl+End to scroll to the end of the program definition and select the last visible node.
- Press Tab to move from the currently selected field to the next updateable field.
- Press Ctrl+Down Arrow to move from the currently selected node to the next node.
- Press Ctrl+Up Arrow to move from the currently selected node to the previous node.

The following example shows the Definition view:



Example of Application Designer Definition view

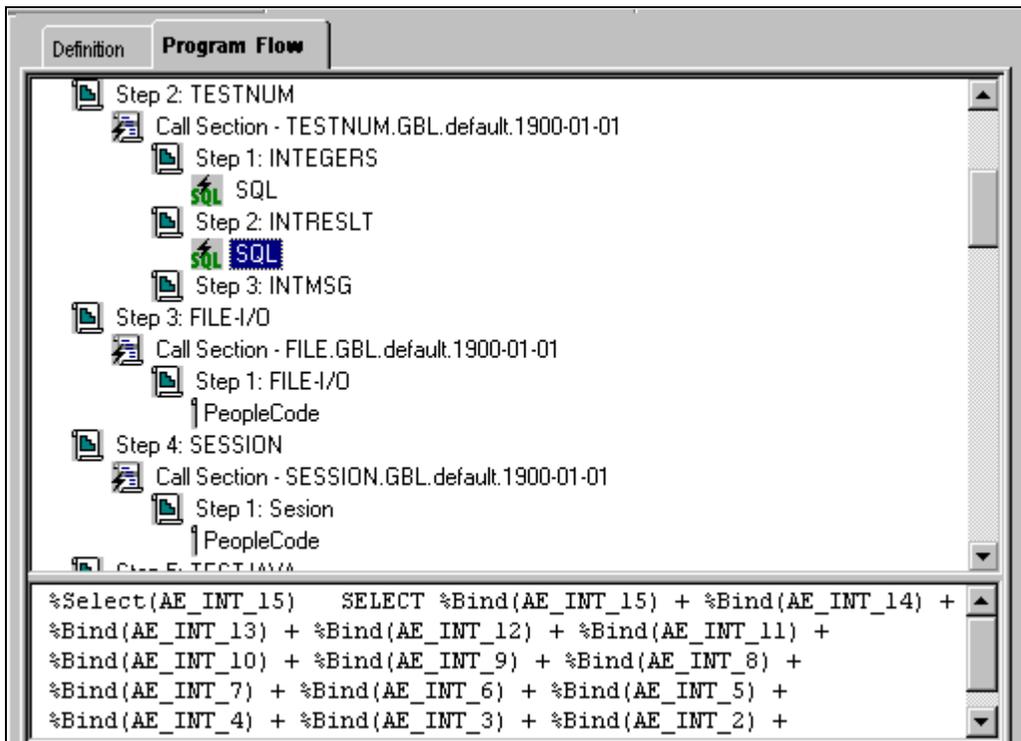
Definition View Pop-up Menu

The following table describes each item you see when you right-click a Definition view window. Certain menu items are enabled only when a particular definition is selected.

Menu Command	Description
View PeopleCode	Launches the PeopleCode Editor with the appropriate PeopleCode loaded. Enabled when a PeopleCode action is selected.
View SQL	Launches the SQL Editor with the appropriate SQL loaded. Enabled when an action containing SQL is selected.
View XSLT	Launches the SQL Editor with the related Extensible Stylesheet Language Transformations (XSLT) text loaded. Enabled only for Transform Only program types when an XSLT action is selected.
Cut	Removes the selected item and copies it to a clipboard. Here, the word <i>clipboard</i> refers to a PeopleTools-only repository for sharing PeopleTools objects. You cannot copy or paste into another program.
Copy	Copies the selected item.
Paste	Pastes the contents of the PeopleTools clipboard (the most recently cut or copied item) to the current location of the cursor.
Delete	Removes the currently selected node from the program definition.
Refresh View	Refreshes the current view and reorders the definition objects as necessary.
Show Comment	Reveals the comments associated with the selected definition object.
Insert Section	Inserts a new section into the current program at the place where the cursor is positioned. This option is enabled only when you have selected MAIN or another section.
Insert Step/Action	Inserts a new step and action within the currently selected section. This option is enabled only when you have selected a section or a step.
Insert Action	Inserts a new action within the currently selected step. This option is enabled only when you have selected a step or action.
Jump to This Program Flow	Switches to the Program Flow view with the first occurrence of the currently selected definition in focus.
Print	Displays the print dialog box for the definition view.
Insert Section Into Project	Applies to sections. Inserts the currently selected section into the current project.

Using Program Flow View

Program Flow view is a read-only view that shows the expected sequence of steps to execute for the program you are developing. The following example shows the Program Flow view:



Example of Application Designer Program Flow view

You can control the amount of detail that appears for each definition by clicking it to expand to the next level. You also can view the SQL or PeopleCode in the lower (splitter) window area by clicking the lower window.

If a primary step node (one that is not the result of a section call) is selected, the Print Options dialog box permits printing to begin either at that step node or the entire program prints. However, if a secondary step node (one that is the result of a section call), a secondary action node, a call section action node, a SQL node, or a PeopleCode node is selected in the Program Flow view, then the Print Options dialog box only permits the entire program to be printed.

To display the pop-up menu for a node, right-click the node. You do not have to select the node first.

You also can display the comments associated with definitions by selecting View, Show All Comments or, for a particular node, right-click and select Show Comment.

You can double-click SQL or PeopleCode statements to launch the editors.

Program Flow Pop-up Menu

The following table describes each pop-up menu item in the Program Flow view:

<i>Menu Command</i>	<i>Description</i>
View PeopleCode	Launches the PeopleCode Editor with the appropriate PeopleCode loaded. Enabled when a PeopleCode action is selected.
View SQL	Launches the SQL Editor with the appropriate SQL loaded. Enabled when an action containing SQL is selected.

Menu Command	Description
Refresh View	Refreshes the current view and reorders the definition objects as necessary.
Show Comment	Reveals the comments for a single definition object that appears in the Program Flow view.
Jump to This Definition	Switches to the Definition view with the first occurrence of the currently selected definition object in focus.
Print	Launches the print dialog box for the program view.

Switching Between Definition and Program Flow Views

By default, navigation within either view does not affect the currently active row in the other view. This functionality enables you to retain your place in one view while scrolling through the other.

To switch between the two views, use any of the following methods:

- View tabs

As with any tabbed interface, if you select a tab, the associated view interface becomes active. When you return to the previous view, it remains positioned on the current or last selected node within the program when you switched. This positioning is true whether you selected the item or just placed the cursor within an edit box.

- View menu

Select a section or step in the current view (note that selecting an action does not enable this functionality; you can jump only from parent nodes). Then select View, Jump to Program Flow or View, Jump to Definition, depending on the currently active view. When you select one of these commands, the focus of the target view depends on what you selected in the previous view. For example, if you selected Section C, Step 4 in Definition view and you select View, Jump to Program Flow, then Section C, Step 4 is the focus of the Program Flow window. If the selected item is in a program that is not open already, then Application Engine opens the appropriate program and navigates to the requested node in the view window.

- Pop-up menu

The same commands as the View menu are also available from the pop-up menu.

Switching Within Program Flow View

While you are in Program Flow view, you can select these options from the pop-up menu:

- Go to Next Reference

Select to switch to the next reference of a particular definition object. This option helps you navigate quickly through a program. For instance, if references to Section C, Step 4 appear three times because of multiple calls to this object at runtime, then you can select Go to Next Reference to navigate quickly and easily to each reference or call.

- Jump to this Definition

Select to go directly to the definition node in the Definition view that pertains to the current selection in the Program Flow view.

Using the Refresh Option

As you develop an Application Engine program, you may be inserting, renaming, and deleting definitions. In a large program, you can easily lose your place or become disoriented. The Refresh option reorders all the nodes for the current definition according to the following logic:

- For standard program definitions, the MAIN section always appears first (Library program types do not contain a MAIN section because they contain only callable sections).

The remaining sections appear alphabetically by name, which makes it easy to locate a section within the program definition. At runtime, the system runs sections through Call Section actions within steps, not by the order in which the sections are defined.

- Steps are never automatically reordered in the Definition view; at runtime, they run in the sequence in which you defined them.
- Actions are always logically reordered within a step based on their action type, which defines their runtime sequence.

Note. When you save a modified definition, the system automatically refreshes the view.

Application Engine inserts any delete requests for a given section into the current project, regardless of the Tools, Options setting in Application Designer.

For example, suppose you delete a section node from the current Application Engine program and then you reinsert a section node and rename it the same name as the section you just deleted. The section object is not inserted into the project, regardless of your Tools, Options setting, because a delete action already exists for this object. To resolve this situation, either remove the delete request manually before inserting the new copy request or reset the proper flags manually in the upgrade project that changes the action type from Delete to Copy.

Filtering View Contents

Section filtering options enable you to filter the current view so that you see only sections and steps based on specified criteria.

To enable or modify the filtering options, select View, Section Filtering. You can select from the filtering options described in this table:

<i>Menu Command</i>	<i>Description</i>
No Filtering	Select to see all objects in your program, regardless of any section attributes such as Market, Database Type, Effective Date, and Effective Status.

Menu Command	Description
Default	Select to display the definition filter according to the default filtering criteria. If you change the value of any filter option and click OK, you have defined a custom filter.
Custom	Select to display the definition filter dialog box and define custom filtering options for the current view.

Behavior of Section Filtering Options

When using the section filtering options, keep in mind that:

- The default is No Filtering; therefore, all section definitions are included in this view.
- If you select Custom filtering, the default filtering options appear while you are in the current session of Application Designer.

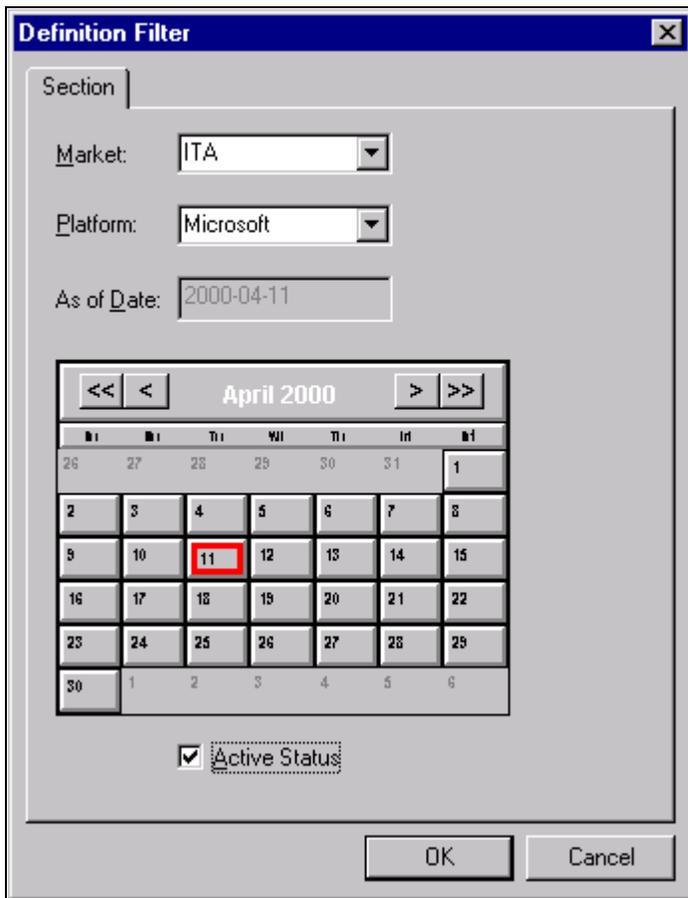
If you modify these filtering options and click OK, the new options are stored as the currently active options and the view is updated accordingly.

- If you select the Default filter option, the original default options appear in the dialog box.

After clicking OK, the view reappears with only those sections that qualify. However, if you change the default options and do not click OK, then these options are stored as a custom filtering request and the view reappears as necessary.

- If no platform-specific section is defined for the target filter value, then the default (base platform) is always included because it represents the Application Engine runtime behavior more accurately.

If you select Section Filtering, Default, or Section Filtering, Custom, then the following dialog box appears:



Definition Filter dialog box

In this example, only definitions that represent the following criteria appear in the Definition and Program Flow views.

Market Select a market code to see only the definitions within that market. To see all market-related definitions for a program, you could update the default profile or define a custom filter by selecting *(none)* from the Market drop-down list box. The example shows only sections that pertain to the Italian market (market code ITA).

Platform Select the platform filtering. The example shows only the sections that are defined for the Microsoft SQL Server platform. Select *Default* to display sections defined to be database-platform-independent (the default platform). Specific platforms include Oracle, DB2 UDB for OS/390 and z/OS, DB2/UNIX, Informix, Microsoft, and Sybase.

As of Date Select the date filtering. The example shows sections with an As of Date equal to or greater than April 7, 2000. Select *None* to display all sections, regardless of effective date.

Active Status Select to show active section definitions.

Note. All filtering options pertain only to section-level nodes.

Printing Program and Flow Definitions

You can print the program definition or program flow, depending on which view you are in when you select Print.

To print an Application Engine program definition:

1. Right-click and select Print in either the Program Flow or Definition view or select File, Print.
2. Select print options.

Program ID	Select to print the whole program.
All Sections	Select for all sections to be expanded in the printed report but <i>only</i> for the primary Application Engine program that is being printed and only if that program is an application library. Otherwise, only the MAIN section, first section, or called section is printed.
All Steps	Select to print all the steps in the section.
All Attributes	Select to print all detail level attributes for the specified node and its children.
SQL Statements	Select to print, for every SQL type action, the text of each SQL statement.
PeopleCode Statements	Select to print the text of the PeopleCode statements for every PeopleCode action.
Comments	Select to print the long description comments for the selected node and its children.
Include External Calls	Select to print the section detail of all external calls.
Max No. of Levels (maximum number of levels)	Specify the maximum number of recursive levels to print for the specified call sections, including both external section calls and internal section calls. This edit box is always enabled. You can only set the maximum number of levels to a value greater than or equal to 1.

Creating, Opening, and Renaming Programs

This section discusses how to:

- Create new programs.
- Open existing programs.

- Rename programs.

Creating New Programs

To create a new program definition:

1. Select File, New or press Ctrl + N.
2. In the New dialog box, select *App Engine Program* from the Definition Type drop-down list and click OK.
3. Save and name your program.

Select File, Save As, enter the name of your program in the Save Name As edit box, and click OK.

Note. You should also provide a program description and specify its owner in the properties dialog box for the new program.

See [Chapter 3, "Creating Application Engine Programs," Setting Program Properties, page 23.](#)

Opening Existing Programs

To open an existing program:

1. Select File, Open.
2. In the Open Definition dialog box, select *App Engine Program* from the Definition Type drop-down list.
3. Enter your search criteria for the program you want, select your program in the search results list, and click Open to open the program.

Renaming Programs

To rename a program:

1. Select File, Rename.
2. In the Rename dialog box, make sure that *App Engine Program* appears as the definition type.
3. In the box that contains your search results, click the program that you want to rename.
4. Click Rename.
5. Place the cursor in the box that appears around the highlighted program name.
6. Enter a new name for the program.

7. Click Rename again and respond appropriately in the Confirm Rename dialog box.

Note. The system automatically modifies all static references in other programs to the renamed program. For instance, if you call the renamed program from another Application Engine program, the Call Section action in the calling program is modified to reflect the new program name. All sections and steps are saved under the new name. Only one occurrence of a program name can exist for a given database.

Note. If the renamed program is called in a dynamic Do action, then the reference is not modified automatically. You should manually check and modify any embedded references to the new program name in CallAppEngine or other PeopleCode functions.

Copying or Moving Program Elements

The following procedures apply to sections, steps, and actions. Note that when these functions are performed for a given object, the result applies not only to the selected object but also includes its defined children, if they exist. Also note that all references to menu items apply not only to the main menu bar items but also to their related items in the context menu, as applicable.

To copy a definition:

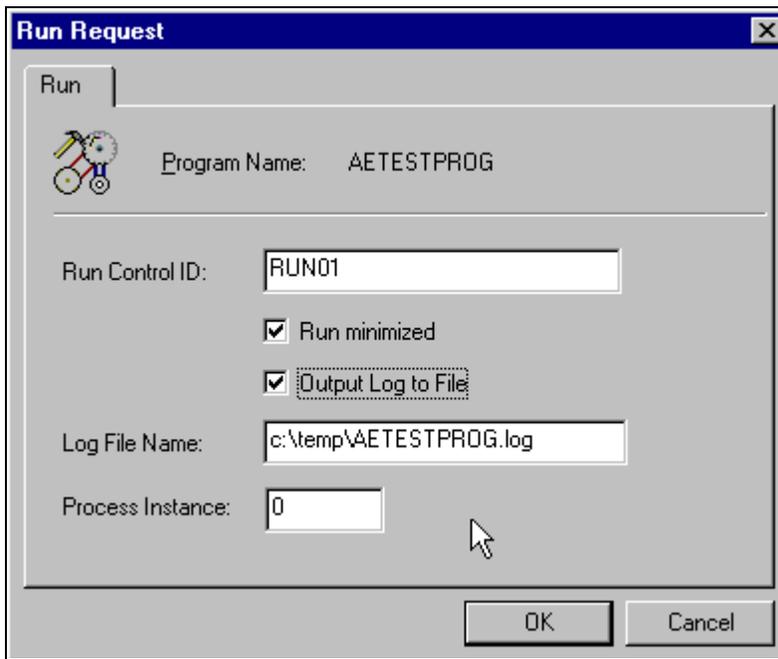
1. Select a definition.
2. Select Edit, Copy.
3. Position the cursor where you want to put the copied definition and select Edit, Paste.

To move a definition:

1. Select a definition object.
2. Select Edit, Cut.
3. Position the cursor at the target location and select Edit, Paste.

Testing Application Engine Programs

After creating or modifying your program, you can test it in two-tier mode while in Application Designer. You use the Run Request dialog box:



Run Request dialog box

To run an Application Engine program in two-tier mode:

1. Select Edit, Run Program from the Application Designer toolbar.

The Run Request dialog box appears.

2. Enter appropriate values.

When you click OK, these values are passed as runtime parameters to the initiated Application Engine runtime executable.

Run Control ID	Enter the run control ID of the program that you are testing.
Run Minimized	Select to have the window of the requested process minimized when it is submitted to run.
Output Log to File	Select to write the output log to a file.
Log File Name	Specify the log file name (enabled only when the Output Log to File check box is selected).
Process Instance	Specify the process instance for this run request or use the default value of zero if you do not need an instance number.

3. Click OK.

Setting Program Properties

This section discusses how to:

- Access properties.
- Set general properties.
- Set state record properties.
- Specify temporary tables.
- Set advanced properties.

Accessing Properties

When you have an Application Engine program open in Application Designer, you can view and modify the properties assigned to an entire program just as you would a step or a section.

To view or modify the properties associated with a program, click the Properties button or select File, Definition Properties while the program is open. You can also press Alt+Enter. The Program Properties dialog box appears.

Setting General Properties

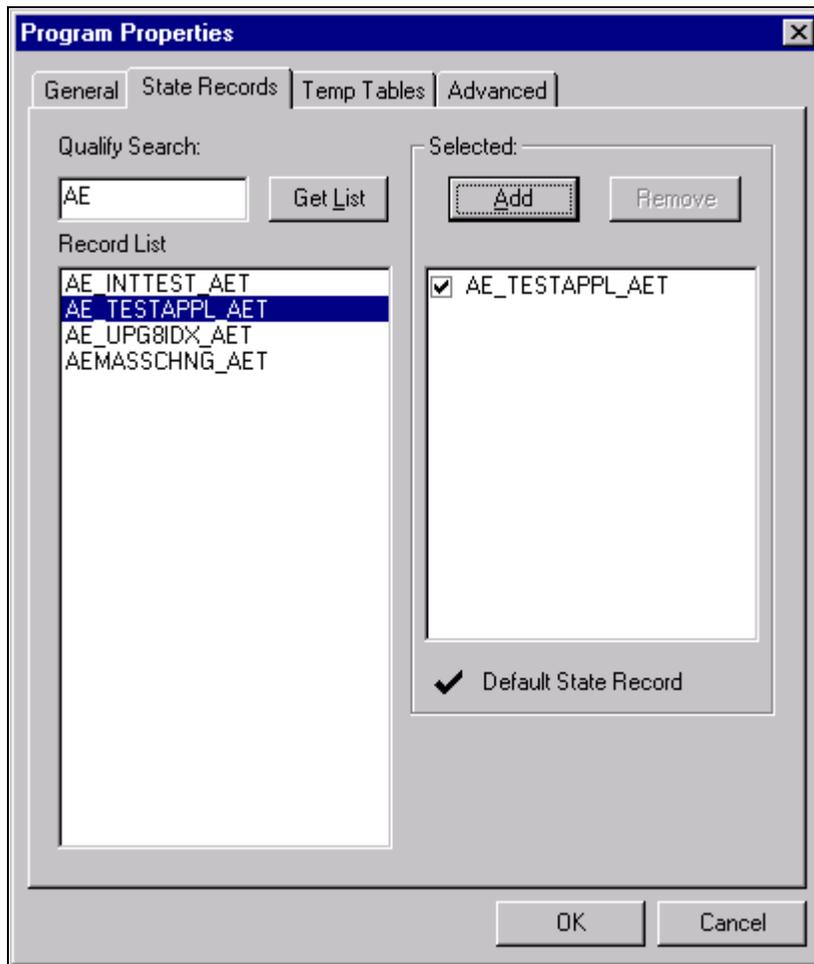
Access the Program Properties dialog box and select the General tab. You can specify identification values for your Application Engine program.

Owner ID

(Optional) Enter the owner ID for the program. The owner ID is a way to identify which definitions are owned by which PeopleSoft applications, such as PeopleSoft General Ledger, Accounts Receivables, and so on. The values in the drop-down list are Translate table values associated with the OBJECTOWNERID field.

Setting State Record Properties

Select the State Records tab.



Program Properties dialog box: State Records tab

Qualify Search

Enter any wildcard characters or complete table names to limit the results that appear in the record list. By default, the Record List text box contains all record names that end with the extension AET. This extension identifies the record as an Application Engine record.

Get List

Click to populate the Record List text box.

Record List

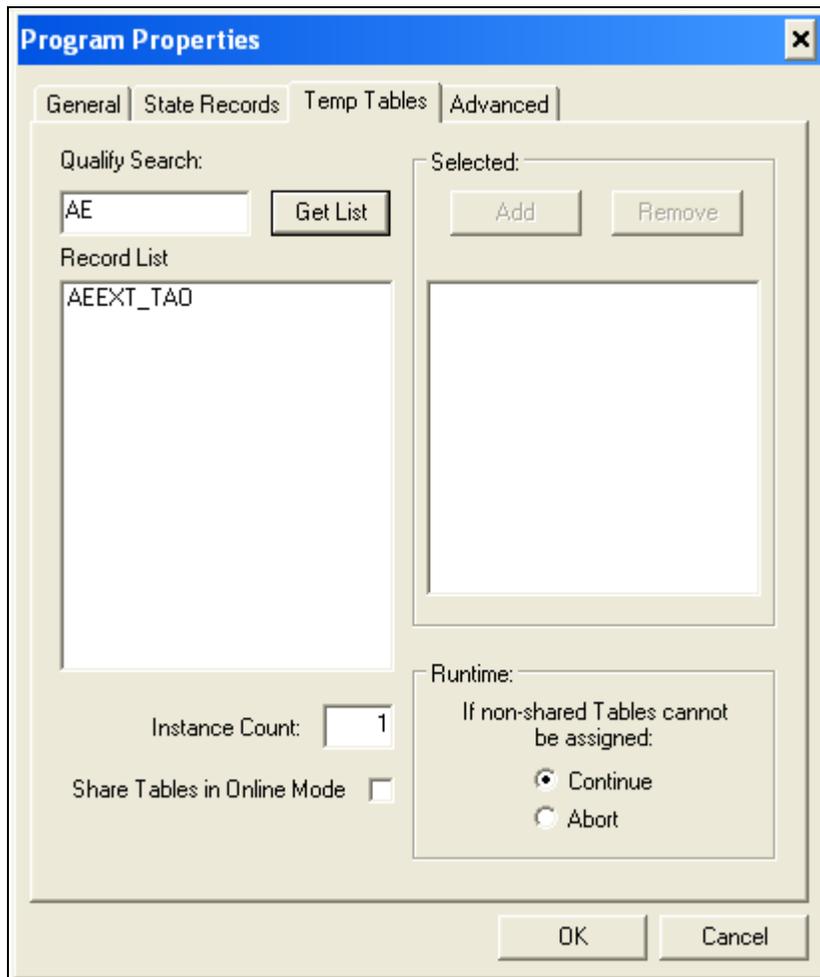
This text box contains the results of your state record search.

Selected

Select state records for use with a particular program. Click Add to include selected records from the record list into the selected list. Click Remove to remove selected records from the selected list. Indicate which state record will act as the default state record by selecting its check box. For your default state record, you need to reference only field names in your PeopleCode and SQL (for the active program). When you reference a non-default state record, you do so by using `rename.fieldname`.

Specifying Temporary Tables

Select the Temp Tables tab.



Program Properties dialog box: Temp Tables tab

Temporary tables store intermediate results during a program run.

Note. You must have defined required temporary tables in your database before you can associate them with an Application Engine program.

Qualify Search

Enter any wildcard characters or complete table names to limit the results that appear in the record list. By default, the Record List text box contains only records that are of type Temporary Table. You apply this attribute when you create the record in Application Designer.

Get List

Click to populate the Record List text box.

Record List

This text box contains the results of your search for temporary tables.

Selected	Select temporary tables for use with a particular program. Click Add to include selected records that appear in the record list. Click Remove to exclude selected records that appear in the selected list.
Instance Count	Enter the number of physical tables to be created for each dedicated table for this program during the SQL Build procedure in Application Designer. Typically, you would set this number to equal the maximum number of parallel program runs that you anticipate. For instance, if you expect up to five instances of the same program to run simultaneously, then you would set the instance count to 5.
Share Tables in Online Mode	Select to enable online temporary table sharing. By default, this check box is not selected. If the temporary tables need to be shared for this particular Application Engine program when run in online mode, this has to be selected. When an online Application Engine instance cannot allocate itself a dedicated temporary table, this instance will share a temporary table already used by another instance(s), improving the online performance.
Insert Selected list into Project	If the active Application Engine program definition belongs to a project, select this check box to include the dedicated temporary tables for this program within the same project.
Runtime	Control how an Application Engine program acts if an instance of its specified dedicated temporary tables is not available. If you select Continue, then Application Engine uses the base version, or undedicated version, of the temporary tables. If you select Abort, then the program exits with an error message.

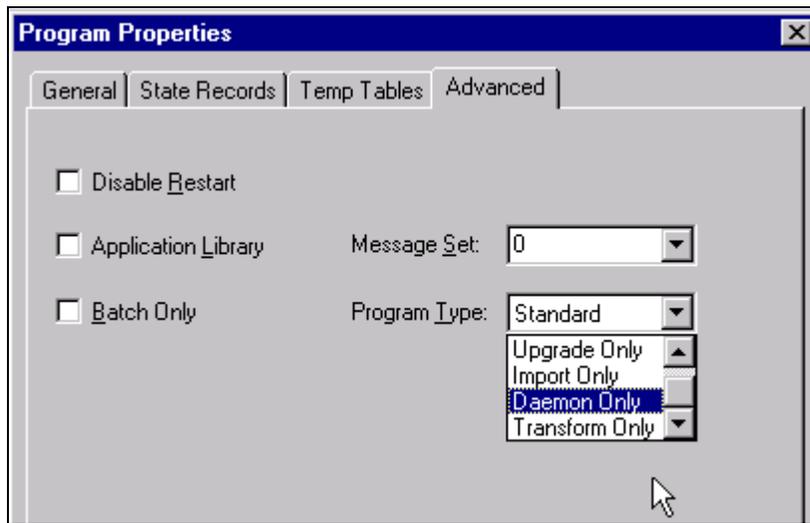
Note. If the table is keyed by PROCESS_INSTANCE and the application SQL includes the process instance in the Where clause, then multiple processes can share the table. The best performance, however, occurs when a program runs against a dedicated temporary table instance.

See Also

[Chapter 9, "Using Temporary Tables," page 163](#)

Setting Advanced Properties

Select the Advanced tab.



Program Properties dialog box: Advanced tab

Disable Restart

Select to disable the built-in restart capabilities for a particular program.

Application Library

In some cases, you may want a program to contain only a collection, or library, of common routines (in the form of callable sections) that you do not want to run as a standalone program. When sections are defined as public, other programs can call the sections, or routines, that exist in the library at runtime. Because this type of program is not designed to run as a standalone program, it does not require the MAIN section, or initial entry point. Select this check box to rename or remove any existing MAIN section.

Note. An application library is the appropriate location to store a collection of shared Application Engine program sections. Libraries are not intended for storing a specific SQL action within a section. To share common SQL, use the SQL repository.

Batch Only

Select for batch-only programs. Batch-only programs are not run from the CallAppEngine PeopleCode function. Any dedicated temporary table used for batch-only programs does not have online instances created.

Message Set

Specify the default message set value for this program. The system uses this message set value for all Log Message actions for which the message set is not specified.

Program Type

Select from:

- *Standard*: Used by standard entry-point programs.
- *Upgrade Only*: Used by PeopleSoft upgrade utilities only.
- *Import Only*: Used by PeopleSoft import utilities only
- *Daemon Only*: Use for daemon type programs.
- *Transform Only*: Support for XSLT programs.

Adding Sections

This section provides an overview of sections and discusses how to:

- Insert sections.
- Locate sections.
- Set section properties.

Understanding Sections

A section comprises steps and is similar to a COBOL paragraph or a PeopleCode function. You can create sections that are platform-independent or platform-specific, intended for a particular market, and effective-dated.

Whenever you create a new program, you simultaneously create a section called MAIN. The MAIN section identifies the entry point of the program so that it can be called by another program.

Section Execution Order

A section is unique based on program and section names, and based on its intended database platform and effective date. When you execute an Application Engine program, it executes sections based on the following order of precedence:

1. If a section for the current market exists, then run it.
Otherwise, execute the default GBL (global) market section.
2. If a section for the current platform, or database exists, execute it.
Otherwise, execute the default database platform section.
3. If multiple effective-dated sections exist, execute the section with the most recent effective date based on the current (run) date.

For example, suppose you have two versions of a particular section, SECT01 for the Public Sector market and SECT01 for the Global market. If you request to run the public sector version of the program, Application Engine executes the Public Sector version of SECT01. If the program is running on Oracle, Application Engine then looks for an Oracle version of SECT01 for Public Sector.

Inserting Sections

To insert a section:

1. Select Insert, Section, or right-click and select Insert Section.

The default name for a section that you insert is Section N, where *N* is an incremental number intended to provide a unique name for each section object. Unless you rename sections, the sections you add are named SectionN+1, where *N* is the last section you inserted. Consequently, the names are Section1, Section2, Section3, and so on.

The designer inserts the new section directly beneath the subordinate objects within the owning section of the highlighted object. For instance, if Section2 were selected, then Section4 would be inserted *between* Section2 and Section3 rather than *after* Section3.

Note. Sections are always reordered alphabetically by name when you save to make locating a section easier. However, run order depends on internal call section references and is, therefore, independent of the order in which sections are inserted and displayed.

2. Enter the remaining section property values.
3. Save the program.

Locating Sections

Various methods are available for locating references to sections within an entire database as well as within a program.

Finding Call Section References

You can generate a list of all the references to a particular section. The list applies only to Application Engine programs defined within a single database.

To locate section references:

1. Open the program containing the shared, or called, section.
2. Select Edit, Find References.

The Find Definition References dialog box appears.

3. On the Call Sections tab, select the appropriate section from the Section name drop-down list or enter the name.

By default, the current program name and MAIN section appear in the dialog box.

4. Click OK.

- In the output window, view the generated list.

The output window lists the programs and sections that call a particular program. This list also shows the total call references made to a particular section. Call sections within the current program appear first in the list.

Double-click an item in the output window list to automatically navigate the definition view to that calling section.

Finding Sections Within the Current Program

Within large and complicated Application Engine programs, such as those upgraded from a previous release, having more than 100 sections is not uncommon. Rather than scrolling through a large program, use the Go To Section feature.

Note. This feature applies only to the current program.

To automatically navigate to a selected section:

- Select Edit, Go To Section.

The Find Definition References dialog box appears.

- On the Go To Section tab, select the appropriate section from the Section name drop-down list or enter the name of the section.
- Click OK.

The Definition view scrolls to the first occurrence of the section with the name you selected.

Setting Section Properties

Controls that specify section properties are located in the Definition view. For example, for each section included in your program, a node, as shown in the following example, appears. You specify all of the attributes to associate with a particular section from this node:

 MAIN	<input type="text" value="MAIN description"/>	MAIN.GBL.(base).1900-01-01				
Market:	Platform:	Effective Date:	Effective Status:	Section Type:	Auto Commit:	Access:
<input type="text" value="GBL"/>	<input type="text" value="(base)"/>	<input type="text" value="01/01/1900"/>	<input type="text" value="Active"/>	<input type="text" value="Prepare Only"/>	<input type="checkbox"/> After Step	<input type="checkbox"/> Public

Section object

The values you specify at the section level generally apply to all the objects contained within that section.

Section Name Develop a naming convention and use it consistently throughout your projects. You are limited to eight characters.

Market Select the market for which the section is intended. If a particular market is irrelevant to your batch program, keep the default market value of Global (GBL).

Platform	Select the target database platform for which this section definition will run. Leave the default value for all sections whose defined actions are not specific to a given database platform.
Effective Date	To make a particular section effective-dated, enter a target date.
Effective Status	Specify whether a section is active or enabled at runtime.
Section Type	If the program terminates abnormally, this value specifies whether you must restart the section. If a section controls a procedure that, if not run to completion, could corrupt or desynchronize your data, then select <i>Critical Updates</i> . Otherwise, accept the default value of <i>Prepare Only</i> .
Auto Commit	Select to specify the commit level for the section. You can have no commit or you can have Application Engine commit after the step successfully completes.
Public	Select to enable a section to be called from another program.

Adding Steps

A step represents the smallest unit of work that can be committed in a program. When you create a program, you have a default MAIN section and step that is initially named Step01.

This section discusses how to:

- Insert steps.
- Set up step properties.

Inserting Steps

To insert a step:

1. Highlight the section or step that you want to precede the new step.

For example, if you want the new step to be the first step in the section, select the section node. Otherwise, select the existing step that you want the new step to follow.

Note. The name of the section in which you insert the step appears to the right of the step description. In large programs, this step enables you to determine the section in which a step resides if the section is not in view. Also, note that a sequence number appears on each step (001, 002, 003, and so on) so that you can determine the order of a step within a section. The sequence numbering for steps begins at 001 within each section.

2. Select Insert, Step/Action.

By default, the steps are given a default name of *StepN+1* beginning with *Step01*. Rename the step to better define the type of action this step contains.

Note. The designer continues to increment the step name until it has a unique step name within a section. If the designer is unable to create a unique name after 50 attempts, a new step is not inserted.

3. Specify a step name and the remaining values.

To rename a step, position the cursor in the step name edit box and enter a custom name. Only accept the default name for building quick, simple programs and for training purposes.

Setting Up Step Properties

You set up step properties in Definition view.

Step Name	Enter a name (up to eight characters).
Commit	Specify the commit level for the step: <ul style="list-style-type: none"> • <i>Default:</i> Select to inherit whatever commit level you specified for the section in which the step resides. • <i>Later:</i> Select to postpone the commit until a subsequent commit occurs. Here you can override the section-level commit if it is set to <i>After Step</i>. • <i>After Step:</i> Select if you have a commit level of <i>None</i> specified at the section level. This selection enables you to override the section-level commit and commit a specific step within a section with no other commits.
Frequency	Enabled only when a step contains one of the following actions: Do While, Do Select, or Do Until. Enter the numeric frequency with which Application Engine should commit. If non-zero, Application Engine commits every <i>N</i> iterations and then again after the last iteration.

On Error

Specify how Application Engine should respond to an error at the step level. The On Error routine behaves the same for both SQL and PeopleCode actions. The program only terminates on errors, not warnings. Select from:

- *Abort*: The application terminates with an error message.
- *Ignore*: The program continues but logs an error message.
- *Suppress*: The program continues and presents no error message.
- *SQL*: Usually a program terminates if a SQL Prepare statement or execute fails. If you select *Ignore* or *Suppress*, errors on running programs are suppressed, but errors on compiles still cause the program to terminate. Thus, if you select to reuse an Update statement, the program fails on the compile if the SQL is incorrect, but it does not fail on a duplicate key error or similar error when the program runs.
- *PeopleCode*: The program has a PeopleCode error if the return code satisfies the statement `If (nRet & PCM_ERROR)`.

Status

Select to activate a step. If the step is currently applicable to your program (and working), you will probably want to keep it active.

Note. The On Error property does not apply to compile errors (for example, specifying erroneous SQL statements). It checks only for execution-type errors. If your program has a syntax error, the program terminates.

Specifying Actions

This section provides an overview of actions and discusses how to:

- Insert actions.
- Set action properties.
- Specify SQL actions.
- Specify Do actions.
- Specify PeopleCode actions.
- Specify Call Section actions.
- Specify Log Message actions.
- Specify XSLT actions.

Understanding Actions

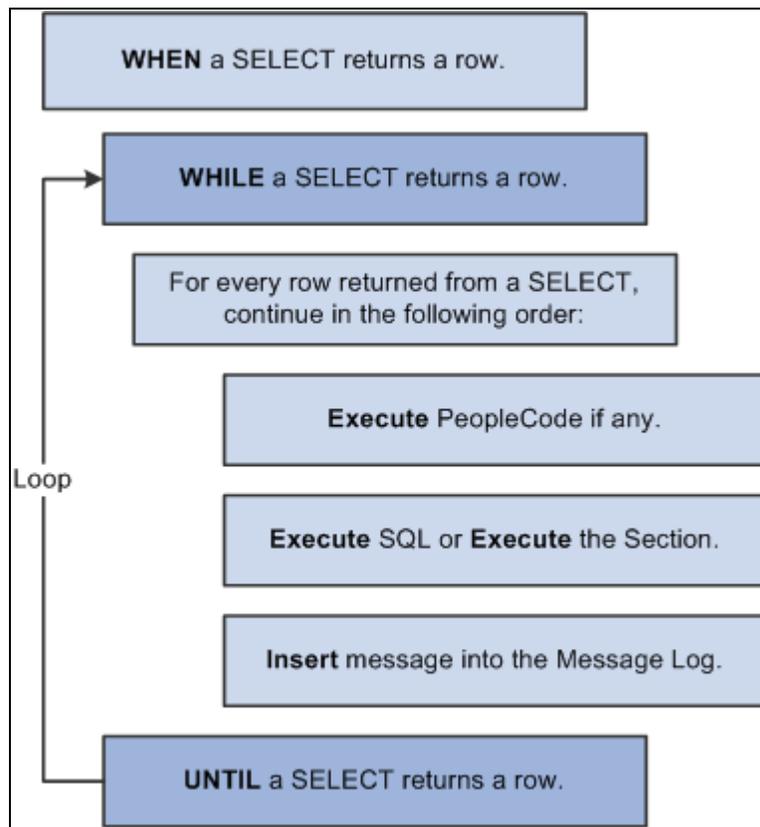
You can include eight types of actions within a step, and a step can contain multiple actions. The actions you define for a step depend on the results that your program requires at each stage of execution.

The only mutually exclusive actions within a single step are Call Section and SQL Statement; you cannot add a Call Section action to a step that already contains a SQL Statement action, and vice versa. You can include only one of each action type within a single step. Because eight types of actions are available and two of these are mutually exclusive, the maximum number of actions a single step can contain is seven.

Action Execution Order

At runtime, the system evaluates actions by type and runs them within a strict hierarchy. For example, if both a Do When and PeopleCode action exist within a given step, then Application Engine always executes the Do When action first.

The following diagram shows the sequence and level of execution for each type of action:



Action execution hierarchy

As you add actions to a step in the Definition view, the actions are initially inserted after the selected definition (the owning step or a previous action). However, following a save request or a refresh of the view, the designer reorders all actions to match the execution hierarchy. This feature helps you visualize the sequence in which each step of your program logic runs.

Note. A SQL action and a Call Section action are interchangeable and mutually exclusive. Only one of these two actions can appear within a step.

When inserting actions, remember that:

- You cannot have more than one action of a specific type within the same step.
- You cannot have a SQL action and a Call Section action within the same step.
- You can define only XSLT type actions for programs defined as Transformation types (see the program properties).

Inserting Actions

To insert an action:

1. Highlight the step in which you want to insert an action.
2. Insert the action.

You do this using one of the following methods:

- Select Insert, Step/Action.
 - Right-click the step and select Insert Step/Action.
3. Select the action type from the drop-down list or, when current action type is selected, enter the first one or two characters of the desired action type and then press Tab. The first (or only) type qualified by your entry is updated in this control.
 4. Enter a description of the action.
 5. Specify the appropriate properties for the action you selected.

Setting Action Properties

To modify action properties, the Definition view must be active. Because you can include a variety of actions within a step, different sets of properties are specific to particular action types. Depending on the action type you select, the properties that appear will change.

For example, you can specify the reuse feature with a SQL action. This feature does not apply to a PeopleCode action; instead, you would need to specify how to respond to the return value of the PeopleCode program.

This example shows how you can select action-specific properties for different action types:

Do Select	<i>Do Select description</i>		
ReUse Statement:		Do Select Type:	
No		Select/Fetch	
Call Section	<i>Call Section description</i>		
Section Name:		Program ID:	
STATS		AETESTPROG <input type="checkbox"/> Dynamic	

Actions and their associated properties

PeopleCode and all SQL action types invoke the related PeopleTools Editor to define or maintain the related text.

ReUse Statement Property

The ReUse Statement property is available for all SQL action types (SQL, Do When, Do While, Do Until, Do Select). You use the ReUse Statement property to optimize the SQL in your batch program. A ReUse Statement converts any %BIND references to state record fields into real bind variables (:1, :2, and so on), enabling the Application Engine runtime process to compile the statement once, dedicate a cursor, and then run it again with new data as often as your program requires. When you use SQL or a Do action to process a large volume of rows one at a time, inside a fetch loop, compiling each statement that you issue can affect performance significantly. ReUse Statement is a way to combat possible performance slowdowns.

Note. You can have Application Engine recompile a reused statement by using the %ClearCursor function.

When setting the ReUse Statement option, choose from these values:

Bulk Insert

When used in conjunction with statements like `INSERT INTO tablename (field1, field2...) VALUES (%BIND(ref1), %BIND(ref2))`, the Bulk Insert feature offers the most powerful performance enhancement related to the ReUse Statement feature. This option turns on a ReUse Statement and, in addition, holds all the data in a buffer and performs an insert only after a large number of rows have gathered in the buffer. The number of rows allowed to gather in the buffer depends on your database platform. Storing data in the buffers is applicable only if you selected *Bulk Insert* and the SQL is an Insert statement. For statements other than Insert, the system ignores the Bulk Insert option.

No

Select this option to disable a ReUse Statement. With ReUse deselected, the Application Engine runtime process recompiles the SQL statement every time the loop runs. By default, a ReUse Statement is disabled.

Yes

Select this option to enable basic ReUse Statement functionality.

Note. The ReUse Statement property can improve performance significantly. However, do not use it if %BIND variables are building parts of the SQL statement or are in the field list of a Select statement (this note does not apply if you use the Static option in %BIND).

Specifying SQL Actions

This is the default action type for the first action within a given step. Use this action to perform the following SQL commands on multiple rows:

- Update
- Insert
- Delete
- Select

Note. Before you insert SQL (select View, SQL) into a SQL action within a new Application Engine program, you must have saved the program previously. Saving is required because the program name you use to save the definition is used to relate your program with the SQL objects you are about to create. The same is true for inserting PeopleCode.

With a SQL action, you use the SQL Editor to create and modify a SQL statement. Following are some examples of SQL statements:

```
%Select(AF_PERFM_AET.PREV_ASOF_DT)
SELECT %DateOut(ASOF_DT)
FROM PS_AF_FCST_SCHT%Bind(EPM_CORE_AET.TABLE_APPEND,NOQUOTES)
WHERE AFDEFN_ID = %Bind(AF_CORE_AET.AFDEFN_ID)
AND ASOF_DT = (SELECT MAX(ASOF_DT)
FROM PS_AF_FCST_SCHT%Bind(EPM_CORE_AET.TABLE_APPEND,NOQUOTES)
WHERE AFDEFN_ID = %Bind(AF_CORE_AET.AFDEFN_ID)
AND ASOF_DT < %Bind(AF_PERFM_AET.ASOF_DT))
```

Note. If you intend to include multiple SQL statements within a single action, you should use the meta-SQL construct %EXECUTE. The previous sample SQL statement sample contains bind variables from a previous Application Engine action.

No Rows Property

In addition to the ReUse Statement property, the No Rows property is available for SQL actions. If the SQL (Insert, Update, or Delete) associated with the SQL action does not return any rows, you must specify what the Application Engine program should do.

For example, you could use the No Rows property when you insert into a temporary table and then intend to perform further operations on the inserted rows (provided that some rows meet the criteria). If the initial combination of Insert and Select statements provides no rows, you could save the program from having to reselect on the temporary table before executing another operation, or you could prevent the program from performing set operations on the table with no qualifying rows.

When you set the No Rows property, choose from the following values:

Abort	The program terminates.
Section Break	Application Engine exits the current section immediately, and control returns to the calling step.

<i>Continue</i>	The program continues processing.
<i>Skip Step</i>	Application Engine exits the current step immediately and moves on to the next step. Application Engine ignores the commit for the current step at runtime. If the current step contains only one action, then use Skip Step only to bypass the commit.

Note. Using the No Rows property in conjunction with a Truncate Table operation is unreliable. Some database platforms report zero rows affected for truncations, regardless of how many rows were in the table.

Specifying Do Actions

Although distinct from the others, these four types of Application Engine actions can be grouped together:

- Do When
- Do While
- Do Until
- Do Select

Use these actions to control the running of your program. These action types enable you to control the execution of subsequent sections, actions, or SQL statements, depending on the results of a Do SQL statement in the form of a Select statement. If you coded in COBOL, you would perform similar actions using the If and While functions.

Any of the Do actions can control the running of a section, a SQL statement, a PeopleCode program, or a log message. For example, a Do Select can run a SQL statement for each row returned by the included Select statement.

Do When

When using a Do When action, note that:

- The Do When action is a Select statement that allows subsequent actions to be run if any rows of data are returned.
- This action is similar to a COBOL If statement.

A Do When statement runs before any other actions in a step. If the Do When statement returns any rows, the next action is executed. If the Do When conditions are not met, the remaining actions within that step are not executed. Your program runs a Do When action only once when the owning step executes.

- The only property that you can specify for a Do When action is the ReUse Statement property, which applies to all SQL-based actions.

Do While

The Do While action is a Select statement that, if present, runs before subsequent actions of the step. If the Do While statement does not return any rows of data, the action terminates. The Do While statement is identical to the COBOL While statement. Subsequent actions within the step are executed in a loop as long as at least one row is returned by the Select statement for the Do While action. If the Do While statement does not return any rows, the step is complete.

The only property that you can specify for a Do While action is the ReUse Statement property, which applies to all SQL-based actions.

Do Until

A Do Until action is a Select statement that runs after each action when a step completes. If the Select statement returns any rows of data, the step terminates. When using a Do Until action, note that:

- You use a Do Until action if you want the processing actions to execute at least once and to execute repeatedly until a certain condition is true, such as a Select statement returns some rows.
- You can use a Do Until action to stop a Do Select action prematurely.

For example, if a Select statement for a Do Until action does not return any rows, then the actions in the step are repeated (except if a Do When action appears in the step). Normally, a Do Select action continues until no rows are returned. If any rows of data are returned, the Do Select action stops and the step is not repeated.

- The only property that you can specify for a Do Until action is the ReUse Statement property, which applies to all SQL-based actions.

Do Select

The Do Select action is a Select statement that executes subsequent actions once for every row of data that the Do Select statement returns. For instance, a Do Select statement can run a SQL statement for each row returned from the Select statement. The subsequent actions within the step are executed in a loop based on the results of the Select statement. The type of the Do Select determines the specific looping rules.

Like the other Do actions, you can specify the ReUse Statement property for the Do Select action; this property applies to all SQL-based actions.

In addition to the ReUse Statement property, you must also specify this Do Select property: *Do Select Type*.

Note. Application Engine does not commit a step containing a Do Select action with the Select/Fetch option enabled until the entire step completes successfully, regardless of the other options you have selected.

For example, suppose at the step level you specified to commit every 100 iterations of the step. One of the actions of this step is a Do Select action with Select/Fetch selected. Because Application Engine does not checkpoint or commit while a Do Select action is active, the transaction performed by the actions within a step is not committed until the entire step completes successfully. This note also applies if any sections are called from inside the loop.

Do Select Type Property

When you specify the Do Select Type property in a Do Select action, you select from the following values:

Select/Fetch

Application Engine opens a cursor for the Do Select action and then, within that cursor, Application Engine performs a Fetch statement for each iteration of the loop to get each row from the Select statement. When a Fetch statement results in an end of table message, the looping is complete. You cannot restart this type of Select statement because Application Engine does not perform a checkpoint or a commit within the step containing this action while Select/Fetch is running. Ultimately, your program ignores the commit settings at runtime until the outermost Select/Fetch completes.

Note. When an Application Engine program is not set up for the capability to restart, then commits are not controlled, monitored, or restricted by Application Engine. When Restart is disabled, commits are controlled by the program.

Re-Select

For each iteration of the loop, Application Engine opens a cursor and fetches the first row. Your program processes the first row returned from the Select statement. The cursor is reopened for each iteration of the loop. With this type of Fetch statement, you typically want some aspect of the loop to eventually cause the Select statement to return no rows. Otherwise, no mechanism is in place by which to exit the loop. This type of Do Select is restartable.

Restartable

This option is similar to *Select/Fetch* in that Application Engine opens the cursor associated with the Do Select action once, and then it performs a Fetch statement on each iteration of the loop to get each row from the Select statement. However, unlike the *Select/Fetch* option, you can restart this action because Application Engine performs a checkpoint in the middle of the step. Application Engine treats this loop as if it is restartable, but it does not manage the restart. Make sure that the SQL you include within this action is such that, upon restart, the program recognizes where the previous run failed and where to restart processing. For example, you can employ a processed switch or base the next Select statement on the key.

Specifying PeopleCode Actions

Use this action type to insert PeopleCode within your Application Engine program. You can invoke the PeopleCode Editor directly from the designer interface to code your PeopleCode programs.

With a PeopleCode action, you can specify only one property: On Return.

Use the On Return value to determine how your Application Engine program reacts based on the return of your PeopleCode program. The On Return setting takes effect if your PeopleCode program issues a "return 1" or "exit 1." You can use the True keyword in place of a non-zero numeric return.

When you specify the On Return property, you select from the following values:

Abort

The program issues an error and exits immediately.

Break

The program exits the current step and section, and control returns to the calling step.

Skip Step

The program exits the current step and continues processing at the next step in the section. If this step is the last one in the section, then the calling step resumes control of the processing.

Specifying Call Section Actions

Use the Call Section action to call another section defined in an Application Engine program. You can call a local section defined within your current program, and you can make external calls to a section defined in another Application Engine program.

The external section you intend to call must have its access property set to Public. If the access property of a section is set to Private, that section can be called only from within the same program. By default, the access property of a section is Private. If you attempt to make a call to a section that does not allow external calls, you receive an error message at runtime.

Note. You can call only programs that reside within the same database as the calling program.

Program ID Property

Because you can call sections defined in the current program or within external programs, you must first specify the program ID of the program containing the section you intend to call.

The default value is (*current*). If you call a section defined in another program, make sure that you first select the appropriate external program from the Program ID drop-down list. This drop-down list contains the names of all program definitions that currently exist in the database.

Section Name Property

Select from names defined in the program that appears in the Program ID list. To call a section that is defined in an external program, select the program name in the Program ID edit box before selecting the section name.

Also use the Call Section action to call an entire external program. First select the program ID, and then select section name MAIN. At runtime, this call executes the entire program defined by the value in the Program ID field.

Note. Application Designer does not prevent you from calling the Main section of the current program or the current section. For instance, Section1 can contain a step that has a local call section reference for Section1. This reference enables recursive calls and should, therefore, be used with caution.

Dynamic Property

Use the AE_APPLID and AE_SECTION fields in the state record to run different sections, depending on the conditions a program encounters during runtime.

You must define these two fields in the default state record for the program. If AE_APPLID is not present or is blank (at runtime), the current program is substituted for the AE_APPLID value. If AE_SECTION is not present or is blank, an error occurs.

When issuing a dynamic call, both the section and the program ID must be dynamically set. You enable a dynamic call by first having your program store different section names in the AE_SECTION field and different program names in AE_APPLID field. The values you insert in these fields are normally based on various conditions met within your program. Then you create a Call Section action that calls the section name defined in the state record field by selecting the Dynamic check box.

Selecting Dynamic automatically populates the AE_SECTION field with the symbolic value %Section and the Program ID field with the symbolic value %AEAPPLID. At runtime, the program calls the section name stored in AE_SECTION that belongs to the program name defined by AE_APPLID.

Program Properties of Called Sections

When you call a section defined in an external program, the current program (the program containing the defined call section) defines the properties that apply to the running process. Suppose tracing is enabled for the current program but disabled for the called program section. In this case, the called program has the trace option enabled at runtime because it inherits the properties of the calling program.

For example, if program A calls program B, and program B calls program C, then the properties of A apply to both programs B and C. The calling program always controls the properties for the called program. In this case, program A controls the properties for program B and because program B inherits the properties of program A, when program B calls program C the properties of program A also apply to program C.

Note. Although program properties are inherited, state records do not follow this inheritance model.

State Records of Called Programs

When you call a program from another program, the default state record of the called program becomes active until processing returns to the initial program. However, all of the state records associated with both programs are available. State records that are common between the two programs share values. To communicate between the two programs or share %BIND variables, define the same state records in both programs.

Specifying Log Message Actions

Use this type of action to write a message to the message log. The message log refers to the PeopleTools table (PS_MESSAGE_LOG) where execution messages reside. Any substitution parameters are written to PS_MESSAGE_LOGPARM. The following example shows a Log Message action:

 Log Message	Log Message description		
	Message Set:	Number:	Parameters:
	10662	278	%BIND(AF_CORE_AET.AFDEFN_ID)

Example of a Log Message action

You can use the Log Message action to insert any type of message. Typically, a Log Message action writes error messages to the message log, but you can also write informational or status messages.

Note. You can also use MessageBox PeopleCode to populate PS_MESSAGE_LOG instead of using the Log Message action. Using MessageBox PeopleCode enables you to record errors encountered within Application Engine PeopleCode programs easily.

Message Set and Number	Select a message defined in the message catalog.
Parameters	Enter values to insert in the log message. This field should be a comma-delimited list of values to substitute for the message variables (%1, %2, and so on) in the message text. These parameters can be hard-coded values or %Bind references. The specified information is inserted into the PS_MESSAGE_LOG at runtime, and any %Bind values are replaced by the current state record field values. Then you can view the logged messages from the Process Monitor page.

For example, using message set 1012, number 10, the message reads "The total number of %1 rows exceeds the control count value, %2," and you need the following parameters:

Invoice, %Bind(CONTROL_CNT)

Suppose you run this program with the CONTROL_CNT field value of 120. When the process ends, the following message would be included on the Process Details dialog box in Process Monitor: "The total number of Invoice rows exceeds the control count value, 120."

Specifying XSLT Actions

You use XSLT actions only for transform programs.

See Also

PeopleTools 8.52: PeopleSoft Integration Broker, "Applying Filtering, Transformation and Translation," Using XSLT for Transformation

Chapter 4

Developing Efficient Programs

This chapter discusses how to:

- Use state records.
- Set commits.
- Reuse statements.
- Use the Bulk Insert feature.
- Use set processing.

Using State Records

This section provides an overview of state records and discusses how to:

- Share state records.
- Choose a record type for state records.

Understanding State Records

You assign variables for your Application Engine program through state records, while sections, steps, and actions pass values to subsequent program steps through state records.

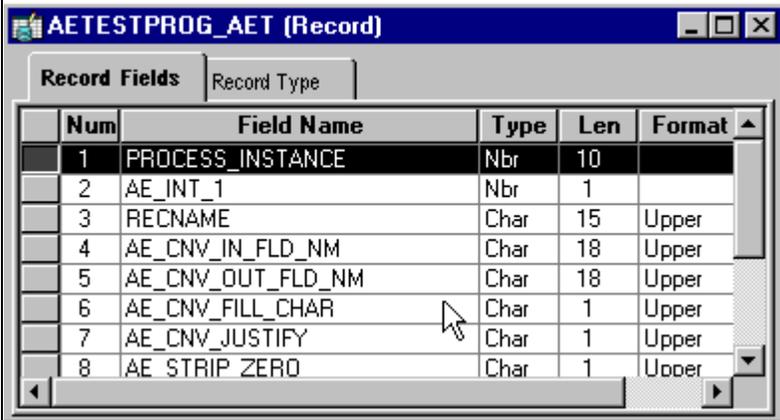
You can have up to 200 state records associated with a particular Application Engine program. However, only one record can be the default state record. You can specify both work (derived) and physical (SQL table) records to be used as state records. The only difference is that derived state records cannot have their values saved to the database at commit time, and so the values are lost during a restart. Therefore, Application Engine erases the contents of derived state records at commit time if Restart is enabled for the current process.

A Application Engine state record must have a process instance defined as the first field and the only key field, and the state record name must end with `_AET`.

Not all the database columns referenced in your program must be in the state record, just the columns that must be selected into memory so those values can be referenced in a subsequent program action. You may also want to include additional fields to hold pieces of dynamic SQL, to use as temporary flags, and so on.

Application Engine supports long fields, unlike COBOL or Structured Query Reports (SQR). However, it allows only one long field per state record. You set a maximum size for the field in Application Designer and make sure that the data space is compatible with the size of the field that you set.

Application Engine also supports image fields and long text fields.



The screenshot shows a window titled "AETESTPROG_AET (Record)" with a "Record Fields" tab selected. Below the tab is a table with the following data:

Num	Field Name	Type	Len	Format
1	PROCESS_INSTANCE	Nbr	10	
2	AE_INT_1	Nbr	1	
3	RECNAME	Char	15	Upper
4	AE_CNV_IN_FLD_NM	Char	18	Upper
5	AE_CNV_OUT_FLD_NM	Char	18	Upper
6	AE_CNV_FILL_CHAR	Char	1	Upper
7	AE_CNV_JUSTIFY	Char	1	Upper
8	AE_STRIP_ZERO	Char	1	Upper

Sample state record

During batch processing, Application Engine automatically performs all state record updates. When a program starts, it inserts a row into the state record that corresponds to the process instance assigned to that program run. Application Engine updates the record whenever a commit operation occurs. When restart is enabled and a commit occurs, all state records that have been updated in memory are written to the database, except for derived state records, which are initialized instead.

After the program completes successfully, Application Engine deletes the corresponding row in the state record. There is only one row in the state record for each process instance. Multiple programs can use the same state record, and each program has its own row based on the unique process instance key.

To set values in the state record, you use the `%SELECT` construct in a SQL statement or write PeopleCode that references the state field with the standard record.field notation. To reference fields in the state record, use the `%BIND` construct.

Sharing State Records

State records can be used by multiple sections and by multiple programs. When you call a section in another program, any additional state records defined for that program (as in state records that are not already in use by the calling program) are initialized, even if the program has been called previously during the run. However, state records that are common to both programs retain their current values.

To reference variables that exist within a state record, use the following:

```
%BIND( fieldname )
```

Unless a specific record name is specified preceding the fieldname, `%BIND` references the default state record. To reference a state record other than the default, use the following:

```
%BIND( recordname . fieldname )
```

In the case of a called program or section, if the called program has its own default state record defined, then Application Engine uses that default state record to resolve the `%BIND(fieldname)`. Otherwise, the called program inherits the default state record of the calling program. In theory, the called program does not require a state record if all the fields it needs for processing exist on the calling program's state record.

For those state records that are shared between programs (during an external call section), any changes made by the called program remain when control returns to the calling program. Any subsequent actions in the calling program can access residual values left in the common state records by the called program. This can be useful to return output values or status to the calling program, yet it can also cause unforeseen errors.

Generally, a called program should not share state records with the caller unless you need to pass parameters between them. Most programs have their own set of state records unless a program calls another program that requires specific input or output variables. In that case, you must include the state record of the called program into the calling program's state record list, and make sure to set the input values before issuing the call section.

Choosing a Record Type for State Records

As a general rule, to preserve state record field values across commits in your program, you should store those values in a state record with a record type of SQL Table. Only derived/work-type state records store values that don't need to be accessed across commits. Derived/work records are, however, an excellent choice for temporary flags and dynamic SQL containers that are set and then referenced immediately. Because these values aren't needed later, you don't want to have to save them to the database at each commit. When you create your state record in Application Designer, you should have an idea regarding how your state record will be used. With this information, you can select the appropriate record type to build.

With Application Engine programs, state records that are derived/work records function the same as SQL Table records. However, there is one notable distinction: unless you have disabled Restart, derived work records have their field values reinitialized after each commit. Therefore, unless you anticipate this behavior, you may encounter problems. One quick way to diagnose such a problem is to examine a trace. Typically, you see %BIND variables resolved to values prior to a commit, and then after the commit, they have no value.

This behavior is necessary to ensure consistency in the event of an abnormal termination and restart. During the restart, Application Engine begins, or restarts, at the point of the last successful commit and restores the values of any state records with corresponding database tables. Derived/work records aren't associated with a physical database table, and consequently they can't be restored in the event of a restart.

Setting Commits

For new Application Engine programs that you develop, by default, the commit values at the section and the step level are turned off. No commits occur during the program run, except for the implicit commit that occurs after the successful completion of the program.

You are responsible for dividing your program into logical units of work by setting commit points within your program. Typically, a good time to commit is after Application Engine completes a self-contained task. How often you apply commits affects how your program performs in the event of a restart. For set processing programs, commit early and often. For row-based processing, commit after every *N* iterations of the main fetch loop that drives the process.

If you have a step with a Do While, Do Until, or a Do Select action, you can set the frequency option, which drives your commit level. This setting enables you to set a commit at the step level that occurs after a specified number of iterations of your looping construct. Application Engine programs commit whenever they are instructed to do so, so you can enable the frequency option as well as have other individual commits inside of a loop.

The only restriction for batch runs occurs when you have restart enabled, and you are inside a Do Select action that is of the Select/Fetch type (instead of Re-select or Restartable). With Select/Fetch, all commits inside the loop are ignored, including the commit frequency if it is set.

The Restartable option is similar to Select/Fetch, except that you are implying to Application Engine that your SQL is structured in such a way that it filters out rows that have been processed and committed. This enables a successful restart. One technique for accomplishing this is to have a processed flag that you check in the Where clause of the Do Select action, and you perform an update inside the loop (and before the commit) to set the flag to *Y* on each row that you fetch.

The commit logic is designed to perform a commit regardless of whether any database changes have occurred. The program commits as instructed, except when the program is restartable and at a point where a commit would affect restart integrity—inside a non-restartable Do Select action, for example.

When you set a step to commit by default, the commit frequency of the step is controlled by the auto commit setting of the section. If the section is set to commit after every step, then the program commits. Otherwise, the program never commits unless the step is explicitly set to commit afterward.

Note. The Commit After, Later setting at the step level enables you to override the section setting if you do not want to commit after a particular step.

%TruncateTable Considerations

Some databases, such as Oracle, issue an implicit commit for a truncate command. If there were other pending (uncommitted) database changes, the results would differ if an abend occurred after the %TruncateTable. To ensure consistency and restart integrity, Application Engine checks the following:

- Whether there are pending changes when resolving a %TruncateTable.
- If the program is at a point where a commit is not allowed.

If either condition is true, Application Engine issues delete from syntax instead.

Considerations with the No Rows Setting

The default for the No Rows setting (on the action) is *Continue*. This setting controls how your program responds when a statement returns no rows. In the case of %UpdateStats, you may want to set No Rows to *Skip Step* and thus skip the commit. For example, suppose you have a single Insert statement into a table, followed by an %UpdateStats. If the stats were current before the Insert statement, and the Insert statement affects no rows, then the %UpdateStats is unnecessary.

Reusing Statements

One of the key performance features of Application Engine is the ability to reuse SQL statements by dedicating a persistent cursor to that statement.

Unless you select the ReUse property for a SQL action, %BIND fields are substituted with literal values in the SQL statement. The database has to recompile the statement every time it runs.

However, selecting ReUse converts any %BIND fields into real bind variables (:1, :2, and so on), which enables Application Engine to compile the statement once, dedicate a cursor, and re-execute it with new data multiple times. This reduction in compile time can improve performance significantly.

In addition, some databases have SQL statement caching. Every time they receive SQL, they compare it against their cache of previously carried out statements to see if they have seen it before. If so, they can reuse the old query plan, but only if the SQL text matches exactly. This circumstance is unlikely with literals instead of bind variables.

When using the ReUse property, note that:

- The ReUse property is valid only for SQL actions.
- Use the ReUse property only if you do not use bind variables for column names.
- Use the ReUse property only if you have no %BIND variables in the Select list.
- If the SQL is dynamic, as in you are using %BIND to resolve to a value other than a standard bind value, and the contents of the bind change each time the statement is executed, then you cannot enable the ReUse property.

In this situation, the SQL is different (at least from the database perspective) each time and, therefore, cannot be reused.

- If you use the NOQUOTES modifier inside %BIND, a STATIC is implied.

For dynamic SQL substitution, the %BIND has a Char field and NOQUOTES to insert SQL rather than a literal value. If you enable the ReUse property, the value of the Char field is substituted inline instead of using a bind marker (as in :1, :2, and so on). The next time that the action is carried out, the SQL that it runs is the same as the previous one, even if the value of a static bind has changed.

- To prepare a reused statement from the beginning, because one of the static binds has changed and the SQL has to reflect that change, use %ClearCursor.
- When making calls to an external section, program, or library, the reusable cursors are retained upon exiting the program. However, if the calling program attempts to call another external section thereafter, the reusable cursors are discarded.

If you are running DB2 on OS/390 or AS/400, use the ReUse property only when you are not using %BINDS as operands of the same operator, as shown in the following example:

```
UPDATE PS_PO_WRK1
SET TAX = %BIND(STATE) + %BIND(FED)
```

This example causes error -417. You can modify the SQL so that you can use the ReUse property successfully. Suppose your program contains the following SQL:

```
UPDATE PS_PO_WRK1
SET TAX = 0
WHERE %BIND(TAX_EXEMPT) = %BIND(TAX_STATUS)
```

If you modify it to resemble the following SQL, the ReUse property works:

```
UPDATE PS_PO_WRK1
SET TAX = 0
WHERE %BIND(TAX_EXEMPT, STATIC) = %BIND(TAX_STATUS)
```

Using the Bulk Insert Feature

By buffering rows to be inserted, some databases can get a considerable performance boost. Application Engine offers this nonstandard SQL enhancement for the following databases: Oracle, Microsoft SQLServer, and DB2. This feature is named Bulk Insert. For those database platforms that do not support the Bulk Insert feature, this flag is ignored.

You should consider using this feature only when an Insert SQL statement is called multiple times in the absence of intervening Commit statements.

Application Engine ignores the Bulk Insert setting in the following situations:

- The SQL is not an Insert statement.
- The SQL is other than an Insert/Values statement that inserts one row at a time.

For instance, the following statements are ignored: Insert/Select, Update, or Delete.

- The SQL does not have a Values clause.
- The SQL does not have a field list before the Values clause.

Note. Application Engine also ignores the Bulk Insert feature when all three of the following conditions are true: the database platform is Oracle, the record contains an EFFDT (effective date) field, and the record contains a mobile trigger. A mobile trigger is required because an Oracle database does not allow the reading of mutating tables in a row trigger.

When the Bulk Insert setting is ignored, Application Engine still runs the SQL; it just does not take advantage of the performance boost associated with the feature.

To prepare or flush a Bulk Insert statement because one of the static binds has changed and the SQL has to reflect that, use %ClearCursor. A flush occurs automatically before each commit.

Using Set Processing

This section provides an overview of set processing and discusses how to:

- Use set processing effectively.
- Avoid row-by-row processing.
- Use set processing examples.

Understanding Set Processing

Set processing is a SQL technique used to process groups, or sets of rows, at one time rather than processing each row individually. Set processing enables you to apply a business rule directly to the data (preferably while it resides in a temporary table) in the database using an Update or Insert/Select statement. Most of the performance gain is because the processing occurs in the database instead of loading the data into the application program, processing it, and then inserting the results back into the database tables. Because the data never leaves the database with set processing (whether it remains in the same table), you effectively eliminate the network round-trip and database API overhead.

Note. Because the updates in set processing occur within the database, use temporary tables to hold transient data while your program runs. Although temporary tables are not required for set processing, they are often essential to achieve optimum performance of your batch program.

Using Set Processing Effectively

The information in the topics that follow applies if you are developing new or upgrading older Application Engine programs to adhere to a set-based model.

SQL Expertise

You should be a SQL expert if you are developing row-by-row programs with Application Engine and especially if you are developing set-based programs. The following concepts are particularly important:

- Group by and Having clauses.
- Complex joins.
- Subqueries (correlated and non-correlated).
- Tools for your database to analyze complex SQL statements for performance analysis.

Typically, you use these SQL constructs to refine or filter a set to contain only the rows that meet specific criteria. In Application Engine, you code using SQL, and Application Engine passes that SQL directly to the database, where it is processed. If you have a complex SQL statement that works functionally, it may not perform well if it is not tuned properly.

Planning

Well-constructed, robust, and efficient Application Engine programs are usually the product of a detailed planning stage in which loops, program flow, the use of temporary tables, sections, steps, and so on are discussed.

Ideally, you should address batch processing as a whole while you are designing the system. Sometimes, system analysts and developers focus primarily on the online system during the database design, and then they consider the batch component within the existing database design. Set processing works best in an environment in which data models are optimized for set processing.

For example, you could have a separate staging table for new data that has not been processed rather than having numerous cases of existing rows in a table being updated. In set processing, processing the data after moving it to a temporary table using an Insert or Select statement is easier than using an update. Avoid performing updates on real application tables, and try to perform your updates on temporary tables. You can structure your data model to minimize updating real application tables.

Another important consideration is keeping historical data separate from active transactions. After the life cycle of given piece of transaction data is over, so that no more updates are possible, consider moving that data to an archive or history table and deleting it from the real transaction table. This action minimizes the number of rows in the table, which improves performance for queries and updates to your active data.

Temporary Tables

Although temporary tables are not required for set processing, well-designed temporary tables complement your set-based program in a variety of ways.

Creating temporary tables enables you to achieve one of the main objectives of set-based processing: the processing remains on the database server. By storing transient data in temporary tables, you avoid the batch program fetching the data, row by row, and running the business rule, processing the data, and then passing the updated data back to the database. If the program ran on the client, you would encounter performance issues because of the network round-trip and the diminished processing speed of a client compared to the database platform.

Design your temporary tables to:

- Hold transaction data for the current run or iteration of your program.
- Contain only those rows of data affected by the business rule.
- Present key information in a denormalized, or flattened, form, which provides the most efficient processing.
- Switch the keys for rows coming from the master tables, if needed.

A transaction may use a different key than what appears in the master tables.

Denormalized Tables

The most efficient temporary tables store data in denormalized form. Because most programs need to access data that resides in multiple tables, you should consolidate all of the affected and related data into one table, a temporary table. The program runs more efficiently against a flattened, temporary table rather than relying on the system to materialize complex joins and views to retrieve or update necessary data for each transaction.

If your program requires the use of a complex view to process transactions, then resolve the view into a temporary table for your program to run against. Each join or view that needs to materialize for each transaction consumes system resources and affects performance. In this approach, the system applies the join or view once (during the filtering process), populates the temporary table with the necessary information that the program needs to complete the transaction, and then runs the program against the temporary table as needed.

For example, consider the following situation:

A program needs to update 10,000 rows in the Customer table, which contains 100,000 rows of data. The Customer table is keyed by setID. To complete the transaction, the program references data that resides in a related table called PS_SET_CNTRL_REC. PS_SET_CNTRL_REC is used to associate setID and BUSINESS_UNIT values. The transaction is keyed by BUSINESS_UNIT.

Given this set of circumstances, the most efficient processing method would be similar to the following:

- Isolate affected or necessary data from both tables and insert it into a temporary table.

Now, instead of dealing with a 10,000-row Customer table and a join to a related table, the program faces a 10,000-row temporary table that contains all of the required data to join directly to the transaction data, which can also be in a temporary table. If all necessary columns reside in the temporary tables, then the program can modify all the rows at once in a simple Update statement.

This example presents two different uses of temporary tables. In one situation, the temporary table is designed to hold setup and control data in a modified form. In the other situation, the temporary table is designed to hold transaction data in a denormalized form, perhaps with additional work columns to hold intermediate calculations.

- Make sure the data appears in a denormalized form for optimum processing.
- Because the transaction is keyed by BUSINESS_UNIT, you should also key the temporary table that holds the control data by BUSINESS_UNIT.

In this case, the table that holds the control data is the Customer table.

Avoiding Row-by-Row Processing

A set-based program and row-by-row processing are not mutually exclusive: some rules do call for row-by-row processing, but these rules are the exceptions. You can have a row-by-row component within a mostly set-based program.

For example, suppose your program contains five rules that you will run against your data. Four of those rules lend themselves well to a set-based approach, while the fifth requires a row-by-row process. In this situation, run the four set-based steps or rules first, and then run the row-by-row step last to resolve the exceptions. Although not pure set-based processing, you will obtain better performance than if the entire program used a row-by-row approach.

When performing a row-by-row update, reduce the number of rows and the number of columns that you select to an absolute minimum to decrease the data transfer time.

For logic that cannot be coded entirely in set, try to process most of the transactions in set and process only the exceptions in a row-by-row loop. A good example of an exception is the sequence numbering of detail lines within a transaction when most transactions have only a single detail line. You can set the sequence number on all the detail lines to 1 by default in an initial set-based operation, and then carry out a Select statement to retrieve only the exceptions (duplicates) and update their sequence numbers to 2, 3, and so on.

Avoid the tendency to expand row-by-row processing for more than is necessary. For example, if you are touching all of the rows in a table in a specific row-based process, you do not necessarily gain efficiency by running the rest of your logic on that table in a row-based manner.

When updating a table, you can add another column to be set in the Update statement. However, do not add another SQL statement to your loop simply because your program is looping. If you can apply that SQL in a set-based manner, then in most cases you achieve better performance with a set-based SQL statement outside the loop.

The rest of this section describes techniques for avoiding row-by-row processing and enhancing performance.

Filtering

Using SQL, filter the set to contain only those rows that are affected or meet the criteria and then run the rule on them. Use a Where clause to minimize the number of rows to reflect only the set of affected rows.

Two-Pass Approach

Use a two-pass approach, wherein the first pass runs a rule on all of the rows and the second pass resolves any rows that are exceptions to the rule. For instance, bypass exceptions to the rule during the first pass, and then address the exceptions individually in a row-by-row manner.

Parallel Processes

Divide sets into distinct groups and then run the appropriate rules or logic against each set in parallel processes. For example, you could split an employee data population into distinct sets of hourly and salary employees, and then you could run the appropriate logic for each set in parallel.

Flat Temporary Tables

Flatten your temporary tables. The best temporary tables are denormalized and follow a flat file model for improved transaction processing.

For example, payroll control data might be keyed by setID and effective dates rather than by business unit and accounting date. Use the temporary table to denormalize the data and switch the keys to business unit and accounting date. Afterwards, you can construct a straight join to the Time Clock table and key it by business unit and date.

Techniques to Avoid

Note that:

- If you have a series of identical temporary tables, examine your refinement process.
- You should not attempt to accomplish a task that your database platform does not support, as in complex mathematics, non-standard SQL, and complex analytical modeling.

Use standard SQL for set processing.

- Although subqueries are a useful tool for refining your set, make sure that you are not using the same one multiple times.

If you are using the same subquery in more than one statement, you should probably have denormalized the query results into a temporary table. Identify the subqueries that appear frequently and, if possible, denormalize the queried data into a temporary table.

Using Set Processing Examples

Each of the following topics contains an example of set processing.

Payroll

In this example, suppose the payroll department needs to give a 1000 USD salary increase to everyone whose department made more than 50,000 USD profit. The following pseudocode enables you to compare the row-by-row and set-based approaches.

- Row-by-Row:

```
declare A cursor for select dept_id from department where profit > 50000;
open A;
fetch A into p_dept_id
while sql_status == OK
    update personnel set salary = (salary+1000) where dept_id = p_dept_id;
    fetch A into p_dept_id;
end while;
close A;
free A;
```

- Set-Based:

```
update personnel set salary = (salary + 1000)
    where exists
        (select 'X' from department
         where profit > 50000
         and personnel.dept_id = department.dept_id)
```

Note. The set-based example employs a correlated subquery, which is important in set-based processing.

Temporary Tables

One technique for improving database performance is to use temporary tables to hold the results of common subqueries. Effective dating and setID indirection are common types of subqueries that you can replace with joins to temporary tables. With the joins in place, you can access the temporary table instead of doing the subquery multiple times. Not only do most databases prefer joins to subqueries, but if you combine multiple subqueries into a single join as well, the performance benefits can be significant.

In this setID indirection example, you see a join from a transaction table (keyed by BUSINESS_UNIT and ACCOUNTING_DT) to a setup table (keyed by SETID and EFFDT).

If using a single SQL statement, you need to bring in PS_SET_CNTRL_REC to map the business unit to a corresponding setID. Typically, you do this in a subquery. You also need to bring in the setup table a second time in a subquery to get the effective date ($\text{MAX}(\text{EFFDT}) \leq \text{ACCOUNTING_DT}$). If you have a series of similar statements, performance may be negatively affected.

The alternative is to use a temporary table that is the equivalent of the setup table. The temporary table is keyed by BUSINESS_UNIT and ACCOUNTING_DT instead of SETID and EFFDT. You populate it initially by joining in your batch of transactions (presumably also a temporary table) once, as described previously, to get all the business units and accounting dates for this batch. From then on, your transaction and setup temporary tables have common keys, which allow a straight join with no subqueries.

For the example, the original setup table (PS_ITEM_ENTRY_TBL) is keyed by SETID, ENTRY_TYPE and EFFDT.

The denormalized temporary table version (PS_ITEM_ENTRY_TAO) is keyed by PROCESS_INSTANCE, BUSINESS_UNIT, ENTRY_TYPE and ACCOUNTING_DT, and carries the original keys (SETID and EFFDT) as simple attributes for joining to other related setup tables, as in PS_ITEM_LINES_TBL for this example.

If the program references the setup table in only one Insert/Select or Select statement, you would not see increased performance by denormalizing the temporary table. But if several SQL statements are typically executed in a single run, all of which join in the same setup table with similar setID and effective date considerations, then the performance cost of populating the temporary table initially provides long-term advantages.

- Original setup table version:

```

INSERT INTO PS_PG_PENDDST_TAO (...)
SELECT
. . . . .
( ( I.ENTRY_AMT_BASE - I.VAT_AMT_BASE ) * L.DST_LINE_MULTIPLR * L.DST_LINE_PERCENT / =>
100 ),

( ( I.ENTRY_AMT - I.VAT_AMT ) * L.DST_LINE_MULTIPLR * L.DST_LINE_PERCENT / 100 ),
. . . . .
FROM PS_PENDING_ITEM I, PS_PG_REQUEST_TAO R, PS_ITEM_LINES_TBL L,
PS_ITEM_ENTRY_TBL E, PS_SET_CNTRL_REC S, PS_BUS_UNIT_TBL_AR B
. . . . .

WHERE
AND L.ENTRY_REASON = I.ENTRY_REASON
AND L.SETID = E.SETID
AND L.ENTRY_TYPE = E.ENTRY_TYPE
AND L.EFFDT = E.EFFDT
. . . . .
AND E.EFF_STATUS = 'A'
AND S.RECNAME = 'ITEM_ENTRY_TBL'
AND S.SETID = E.SETID
AND S.SETCNTRLVALUE = I.BUSINESS_UNIT
AND E.ENTRY_TYPE = I.ENTRY_TYPE
AND E.EFFDT = (SELECT MAX(EFFDT) FROM PS_ITEM_ENTRY_TBL Z
WHERE Z.SETID = E.SETID
AND Z.ENTRY_TYPE = E.ENTRY_TYPE
AND Z.EFF_STATUS = 'A'
AND Z.EFFDT <= I.ACCOUNTING_DT )
AND B.BUSINESS_UNIT = I.BUSINESS_UNIT
/

```

- Denormalized temporary table version:

```

INSERT INTO PS_ITEM_ENTRY_TAO
. . . . .
SELECT DISTINCT %BIND(PROCESS_INSTANCE), I.BUSINESS_UNIT, I.ACCOUNTING_DT,
E.ENTRY_TYPE...
. . .
FROM PS_PENDING_ITEM I, PS_PG_REQUEST_TAO R,
PS_ITEM_ENTRY_TBL E, PS_SET_CNTRL_REC S, PS_BUS_UNIT_TBL_AR B
WHERE R.PROCESS_INSTANCE = %BIND(PROCESS_INSTANCE)
AND R.PGG_GROUP_TYPE = 'B'
AND I.POSTED_FLAG = 'N'
AND R.GROUP_BU = I.GROUP_BU
AND R.GROUP_ID = I.GROUP_ID
AND E.EFF_STATUS = 'A'
AND S.RECNAME = 'ITEM_ENTRY_TBL'
AND S.SETID = E.SETID
AND S.SETCNTRLVALUE = I.BUSINESS_UNIT
AND E.ENTRY_TYPE = I.ENTRY_TYPE
AND E.EFFDT = ( SELECT MAX(EFFDT) FROM PS_ITEM_ENTRY_TBL Z
WHERE Z.SETID = E.SETID
AND Z.ENTRY_TYPE = E.ENTRY_TYPE
AND Z.EFF_STATUS = 'A'
AND Z.EFFDT <= I.ACCOUNTING_DT )
AND B.BUSINESS_UNIT = I.BUSINESS_UNIT
/
INSERT INTO PS_PG_PENDDST_TAO (...)
SELECT ...
( (I.ENTRY_AMT_BASE - I.VAT_AMT_BASE) * L.DST_LINE_MULTIPLR * L.DST_LINE_PERCENT / =>
100 ),
( (I.ENTRY_AMT - I.VAT_AMT) * L.DST_LINE_MULTIPLR * L.DST_LINE_PERCENT / 100 ),
. . . . .
FROM PS_PENDING_ITEM I, PS_PG_REQUEST_TAO R, PS_ITEM_LINES_TBL L,
PS_ITEM_ENTRY_TAO E
. . . . .
WHERE
. . . . .
AND L.ENTRY_REASON = I.ENTRY_REASON
AND L.SETID = E.SETID
AND L.ENTRY_TYPE = E.ENTRY_TYPE
AND L.EFFDT = E.EFFDT
. . . . .
AND E.BUSINESS_UNIT = I.BUSINESS_UNIT
AND E.ACCOUNTING_DT = I.ACCOUNTING_DT
AND E.ENTRY_TYPE = I.ENTRY_TYPE
/

```

Platform Issues

Set processing does not behave the same on every database platform. On some platforms, set processing can encounter performance breakdowns. Some platforms do not optimize update statements that include subqueries.

For example, environments that are accustomed to updates with subqueries get all the qualifying department IDs from the Department table and then, using an index designed by an application developer, update the Personnel table. Other platforms read through every employee row in the Personnel table and query the Department table for each row.

On platforms where these types of updates are a problem, try adding some selectivity to the outer query. In the following example, examine the SQL in the Before section and then notice how it is modified in the After section to run smoothly on all platforms. You can use this approach to work around platforms that have difficulty with updates that include subqueries.

Note. In general, set processing capabilities vary by database platform. The performance characteristics of each database platform differ with more complex SQL and set processing constructs. Some database platforms allow additional set processing constructs that enable you to process even more data in a set-based manner. If performance needs improvement, you must tailor or tune the SQL for your environment. You should be familiar with the capabilities and limitations of your database platform and be able to recognize, through tracing and performance results, the types of modifications you need to incorporate with the basic set processing constructs described.

- Basic version:

```
UPDATE PS_REQ_LINE
SET SOURCE_STATUS = 'I'
WHERE
EXISTS
(SELECT 'X' FROM PS_PO_ITM_STG STG
WHERE
STG.PROCESS_INSTANCE =%BIND(PROCESS_INSTANCE) AND
STG.PROCESS_INSTANCE =PS_REQ_LINE.PROCESS_INSTANCE AND
STG.STAGE_STATUS = 'I' AND
STG.BUSINESS_UNIT = PS_REQ_LINE.BUSINESS_UNIT AND
STG.REQ_ID = PS_REQ_LINE.REQ_ID AND
STG.REQ_LINE_NBR = PS_REQ_LINE.LINE_NBR)
```

- Optimized for platform compatibility:

```
UPDATE PS_REQ_LINE
SET SOURCE_STATUS = 'I'
WHERE
PROCESS_INSTANCE = %BIND(PROCESS_INSTANCE) AND
EXISTS
(SELECT 'X' FROM PS_PO_ITM_STG STG
WHERE
STG.PROCESS_INSTANCE =%BIND(PROCESS_INSTANCE) AND
STG.PROCESS_INSTANCE =PS_REQ_LINE.PROCESS_INSTANCE AND
STG.STAGE_STATUS = 'I' AND
STG.BUSINESS_UNIT = PS_REQ_LINE.BUSINESS_UNIT AND
STG.REQ_ID = PS_REQ_LINE.REQ_ID AND
STG.REQ_LINE_NBR = PS_REQ_LINE.LINE_NBR)
```

Note. This example assumes that the transaction table (PS_REQ_LINE) has a PROCESS_INSTANCE column to lock rows that are in process. This is another example of designing your database with batch performance and set processing in mind.

This modification enables the system to limit its scan through PS_REQ_LINE to only those rows that the program is currently processing. At the same time, it enables a more set-friendly environment to first scan the smaller staging table and then update the larger outer table.

Chapter 5

Using Meta-SQL and PeopleCode

This chapter provides an overview of Application Engine meta-Structured Query Language (SQL) and discusses how to:

- Use PeopleCode in Application Engine programs.
- Include dynamic SQL.
- Use Application Engine meta-SQL.

Understanding Application Engine Meta-SQL

Application Engine meta-SQL is divided into the following categories:

- **Construct**
A construct is a direct substitution of a value that helps to build or modify a SQL statement.
- **Function**
A function performs an action on its own or causes another function to be called.
- **Meta-variable**
A meta-variable allows substitution of text within SQL statements.

Note. Some meta-SQL elements can be used only in Application Engine programs, some can be used both in Application Engine programs and in other environments, and some cannot be used in Application Engine programs at all. This PeopleBook discusses only meta-SQL elements that can be used in Application Engine. You can find a complete reference to all PeopleSoft meta-SQL elements in *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

[Chapter 5, "Using Meta-SQL and PeopleCode," Using Application Engine Meta-SQL, page 74](#)

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," Understanding Meta-SQL

Using PeopleCode in Application Engine Programs

This section provides an overview of PeopleCode and Application Engine programs and discusses how to:

- Decide when to use PeopleCode.
- Consider the program environment.
- Access state records with PeopleCode.
- Use If/Then logic.
- Use PeopleCode in loops.
- Use the AERSection class.
- Make synchronous online calls to Application Engine programs.
- Use the file class.
- Call COBOL modules.
- Call PeopleTools application programming interfaces (APIs).
- Use the CommitWork function.
- Call WINWORD Mail Merge
- Use PeopleCode examples.

Understanding PeopleCode and Application Engine Programs

Inserting PeopleCode into Application Engine programs enables you to reuse common function libraries and improve performance. In many cases, a small PeopleCode program used instead of Application Engine PeopleCode is an excellent way to build dynamic SQL, perform simple If/Else edits, set defaults, and perform other tasks that do not require a trip to the database.

Scope of Variables

This table presents the different types of variables typically used in Application Engine programs and their scope:

Type of Variable	Scope	Comments
State record (work record)	Transaction (unit of work)	Using a work record as your Application Engine state record means that the values in the work record cannot be committed to the database. Commits happen as directed, but any values in work records are not retained after a commit.
State record (database record)	Application Engine program	Using a database record as your Application Engine state record preserves the values in the state record on commit, and the committed values are available in the event of a restart.
Local PeopleCode variables	PeopleCode program	Local PeopleCode variables are available only for the duration of the PeopleCode program that is using them.
Global PeopleCode variables	Application Engine program	Global PeopleCode variables are available during the life of the program that is currently running. Any global PeopleCode variables are saved when an Application Engine program commits and checks points; therefore, they are available in the event of a restart.
Component PeopleCode variables	Application Engine program	Component PeopleCode variables act like global variables in Application Engine.

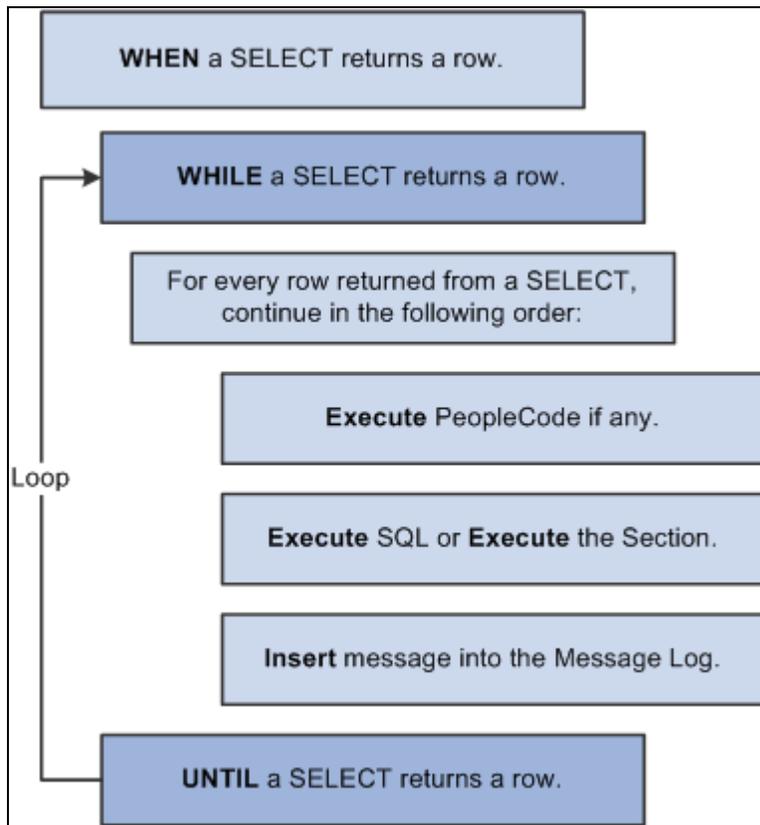
Action Execution Order

A step can contain only one PeopleCode action because no other types of actions are required within a step in conjunction with a PeopleCode action (or program). If you include other actions with your PeopleCode action within the same step, keep in mind the hierarchy when you run it.

With PeopleCode actions, Application Engine runs the PeopleCode program *before* the SQL, Call Section, or Log Message actions, but a PeopleCode program runs *after* any program flow checks.

Because multiple action types exist, they must execute in agreement within a system; therefore, the order in which actions execute is significant. At runtime, actions defined for a given step are evaluated based on their action type. All of the action types exist within a strict hierarchy of execution. For example, if both a Do When action and a PeopleCode action exist within a given step, then the Do When action always runs first.

The following example shows the sequence and level of execution for each type of action:



Example of action execution hierarchy

Deciding When to Use PeopleCode

Application Engine is not intended to run programs that include only PeopleCode actions. The primary purpose of Application Engine is to run SQL against your data.

Use PeopleCode primarily for setting If, Then, Else logic constructs, performing data preparation tasks, and building dynamic portions of SQL statements; rely on SQL to complete the bulk of actual program processing. Also use PeopleCode to reuse previously developed online logic. PeopleCode is the tool to use to take advantage of new technologies such as component interfaces and application classes.

Most programs must verify that a certain condition is true before they run a particular section. For example, if the hourly wage is less than or equal to *X*, do Step A; if not, fetch the next row. In certain instances, you must modify variables that exist in a state record. PeopleCode enables you to set state record variables dynamically.

Avoid rowset processing in an Application Engine program. Loading data into a rowset can use a significant amount of memory, which this formula approximates:

$$\text{mem} = \text{nrows} * (\text{row overhead} + \text{nrecords} * (\text{rec overhead} + \text{nfields} * (\text{field overhead}) + \text{average cumulative fielddata}))$$

where

- mem is the amount of memory required to store the rowset.
- nrows is the number of rows.

- `row overhead` is the overhead per row.
- `nrecords` is the number of records per row.
- `rec overhead` is the record overhead (approximately 40 bytes).
- `nfields` is the number of fields in the record.
- `field overhead` is the overhead per field (approximately 80 bytes).
- `average cumulative fielddata` is the average amount of data per field.

Using this formula, a rowset containing 500,000 rows with one record per row, 50 fields, and 200 bytes per field would require approximately 2.3 gigabytes of memory.

Considering the Program Environment

When writing or referencing PeopleCode in a PeopleCode action, you must consider the environment in which the Application Engine program runs. *Environment* indicates the differences between online and batch modes. Application Engine programs usually run in batch mode; consequently, your PeopleCode cannot access pages or controls as it can while running in online mode. Any PeopleCode operations that manipulate pages will not run successfully. Even if you invoke your Application Engine program online from a record or a page using the `CallAppEngine` PeopleCode function, the Application Engine PeopleCode still does not have direct access to component buffers.

Any record field references that appear in a PeopleCode action can refer only to fields that exist on an Application Engine state record. Component buffers, controls, and so on are still inaccessible even if you define the page records as state records in the Program Properties dialog box. An Application Engine program can access only state records or other objects you create in PeopleCode.

However, you do have several options for passing data from a component buffer to an Application Engine program: you can use the `CallAppEngine` PeopleCode function or you can define global variables.

Passing Parameters Through the CallAppEngine Function

For individual page fields and simple PeopleCode variables such as numbers and strings, you can use the `CallAppEngine` PeopleCode function to pass values as parameters.

To use the `CallAppEngine` function:

1. Declare a record object in PeopleCode.

For example, `Local Record &MyRecord;`

2. Assign record objects to any state record that you want to pass to the Application Engine program.

Record objects are parameters to the `CallAppEngine` function.

3. Set the appropriate values on that state record.
4. Include the record object in the function call.

After these values are set in the state record, all the actions in a particular program, not just the PeopleCode actions, can use the values.

Defining Global Variables

You can define global variables or objects in PeopleCode before you call an Application Engine program. Application Engine PeopleCode actions are able to access only the variables you define; however, the PeopleCode could set a state record field equal to a number or string variable for use by other Application Engine actions.

Also, an Application Engine PeopleCode program can read or update a scroll area or a grid using a global rowset object. When accessing a scroll area or a grid from Application Engine PeopleCode, the same rules apply and the same illegal operations are possible that you see with accessing PeopleCode not in an Application Engine program.

The parameters submitted in a CallAppEngine are by value. These parameters seed the specified Application Engine state record field with a corresponding value. If that value changes within Application Engine by updating the state record field, then the component data will not be affected. The only way to update component buffers or external PeopleCode variables from Application Engine is to use global PeopleCode variables and objects.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "PeopleCode Built-in Functions," CallAppEngine

Accessing State Records with PeopleCode

Running PeopleCode from Application Engine steps enables you to complete some simple operations without having to use SQL. For example, to assign a literal value to an Application Engine state record field using SQL, you may have issued a statement similar to this one:

```
%SELECT (MY_AET.MY_COLUMN)
SELECT 'BUSINESS_UNIT' FROM PS_INSTALLATION
```

You can use a PeopleCode assignment instead:

```
MY_AET.MY_COLUMN = "BUSINESS_UNIT" ;
```

Similarly, you can use a PeopleCode If statement instead of a Do When action to check the value of a state record field.

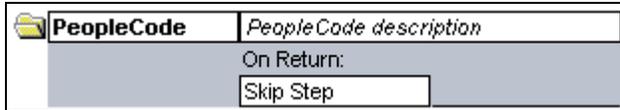
When accessing state records with PeopleCode, keep in mind that:

- State records are unique to Application Engine programs.
- Within Application Engine PeopleCode, state record values can be accessed and modified using the standard `recordname.fieldname` notation.

Note. When you launch an Application Engine program from PeopleSoft Process Scheduler, you can generate a process warning status after the program completes by including and modifying the AE_APPSTATUS field in a state record. You can generate the warning status by setting AE_APPSTATUS to a value of 1.

Using If/Then Logic

From PeopleCode, you can trigger an error status, or false return, by using the Exit function. Use the On Return value in the PeopleCode action properties to specify how your Application Engine program behaves according to the return of your PeopleCode program. This example shows the On Return property:



Example of On Return action property

By default, the program terminates, similar to what happens when a SQL error occurs. By changing the On Return value to *Skip Step*, however, you can control the flow of your Application Engine program.

You can use Exit to add an If condition to a step or a section break. For example:

```
If StateRec.Field1 = 'N'
Exit(1);
Else
/* Do processing */
End-if;
```

You must specify a non-zero return value to trigger an On Return action. The concepts of "return 1" and "return True" are equivalent; therefore, if the return value is non-zero or True, then Application Engine performs what you specify for On Return, as in *Abort* or *Skip Step*. However, if the program returns zero or False, Application Engine ignores the selected On Return value.

Using PeopleCode in Loops

You can insert PeopleCode inside of a Do loop, but be careful when using PeopleCode inside of high-volume Do loops (While, Select, Until). Minimize the number of distinct programs inside the loop. You should avoid having PeopleCode perform the actual work of the program and instead use it primarily to control the flow (If, Then logic), build dynamic SQL, or interact with external systems.

Using bind variables instead of literals to pass values to SQL statements is essential in PeopleCode loops or if the PeopleCode is called in a loop. If the PeopleCode loops, Application Engine probably will use a dedicated cursor, which saves the overhead of recompiling the SQL for all iterations. If the PeopleCode is called from within a loop, Application Engine does not reduce the number of compiles, but it avoids flooding the SQL cache (for those database servers that support SQL cache) when it uses bind variables. Do not use bind variables for values in a Select list or for SQL identifiers, such as table and column names, as some databases do not support them.

Note. Null bind values of type DateTime, Date, or Time are always resolved into literals.

On database platforms for which this feature is implemented, setting BulkMode to True often results in significant performance gains when inserting rows into a table within a loop.

In general, avoid PeopleCode calls within a loop. If you can call the PeopleCode outside of the loop, use that approach to increase overall performance.

Using the AERSection Class

The AERSection PeopleCode class enables you to change the properties of an Application Engine program section dynamically, without having to modify any of the Application Engine tables directly. This capability enables you to develop rule-based applications that conform dynamically to variables that a user submits through a page, such as the Application Engine Request page.

The AERSection class provides the following flexibility:

- Portions of SQL are determined by checks before a run.
- The logic flow conforms as rules change, and the program adjusts to the rules.

When using an AERSection object:

- Ensure that you require primarily dynamic capabilities with the SQL your program generates.
- Ensure that the rules to which your program conforms are relatively static or at least defined well enough that a standard template could easily accommodate them.
- Consider using SQL definitions to create dynamic SQL for your programs to avoid the complexity created by the AERSection object using the StoreSQL function.
- The AERSection class is designed to dynamically update SQL-based actions only, not PeopleCode, Call Section, or other actions.

You can add a PeopleCode action to your generated section, but you cannot alter the PeopleCode.

- The AERSection class is designed to use for online processing.

Typically, dynamic sections should be constructed in response to a user action.

Note. Do not call an AERSection object from an Application Engine PeopleCode action.

See Also

PeopleTools 8.52: PeopleCode API Reference, "AERSection Class"

Making Synchronous Online Calls to Application Engine Programs

To make synchronous online calls to an Application Engine program, use the PeopleCode function CallAppEngine.

Note. If you make a synchronous call, users cannot perform another PeopleSoft task until the Application Engine program completes. Consider the size and performance of the Application Engine program called by CallAppEngine. You should ensure that the program will run to successful completion consistently within an acceptable amount of time.

If an Application Engine program called by CallAppEngine terminates abnormally, the user receives an error, similar to other save time errors, that forces the user to cancel the operation. The CallAppEngine function returns a value based on the result of the Application Engine call. If the program was successful, it returns a zero; if the program was unsuccessful, it returns a value other than zero.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "PeopleCode Built-in Functions," CallAppEngine

Using the File Class

The file layout class enables you to perform file input and output operations with Application Engine using PeopleCode. A file object enables you to open a file (for reading or writing), read data from a file, or write data to it. Using the combination of the file class and Application Engine provides an effective method to integrate (or exchange) the data stored in a legacy system with your PeopleSoft system. The file class facilitates the creation of a flat file that both your legacy system and Application Engine programs support.

An Application Engine program running on the application server uses a file object to read the file sent from the legacy system and to translate it so that the file can update affected PeopleSoft application tables. For the PeopleSoft system and the legacy system to communicate, you first must construct a file object that both systems can use to insert and read data.

Attain rowset and record access for a file using a file layout definition. You create the file layout definition in Application Designer, and it acts as a template for the file that both systems read from and write to. This file layout definition simplifies reading, writing, and manipulating complex transaction data with PeopleCode.

Generally, use the file class and Application Engine combination when you cannot implement the PeopleSoft Integration Broker solution.

See Also

PeopleTools 8.52: PeopleCode API Reference, "File Class"

Calling COBOL Modules

Using the PeopleCode RemoteCall function, you can call COBOL modules from a PeopleCode action. This option supports existing Application Engine programs that call COBOL modules. You also can use it to upgrade Application Engine programs from previous releases.

PTPECOBL Program

The PTPECOBL interface program is a PeopleSoft executable that enables you to invoke your called COBOL module and pass it required values. You code the RemoteCall function to invoke PTPECOBL, which in turn calls the specified COBOL module.

If you use PTPECOBL, you do not have to write your own executable to process this task. However, PTPECOBL does not perform any SQL processing other than retrieving a list of state record values. Consequently, if your current logic requires previous SQL processing, you may want to write your own executable file to call your COBOL module. In most situations, PTPECOBL saves you from having to write a custom executable file to handle each call to a generated dynamically loadable code (.GNT) file.

PTPECOBL performs the following tasks:

1. Initializes the specified state record in memory.
2. Invokes the COBOL module specified in your PeopleCode.
3. Submits required parameters to the called COBOL module.
4. Updates the state record as necessary, issues a commit, and then disconnects from the database after your program completes.

Note. While your COBOL program runs, it can access and return values to the state record.

Shared Values in Application Engine and COBOL

The following options are available for sharing values between the Application Engine program and a called COBOL program:

- Use state records.

If you add field names, Application Engine enables you to pass state record values to the called COBOL program and to get changes passed back to the calling PeopleCode program. If you pass the state record values in this way, use PTPECACH to retrieve and update values just as PTPEFCNV does.

- Code custom SQL.

If you do not pass initial values using state record fields, you need to insert the appropriate SQL in your called COBOL module to retrieve the appropriate values. Then, to return any updated values to the calling Application Engine program, you must insert the appropriate SQL into a PeopleCode program.

If your COBOL program needs values that do not appear in a state record field, then you can pass PeopleCode variables and values. These variables and values are then retrieved and updated by calling PTPNETRT from within your COBOL program.

- Create a custom executable file.

If you include extra SQL processing and use non-state record values, for consistency purposes, creating a custom executable file might be a better approach. It enables you to call your program directly and have it perform all the PTPNETRT processing. Remember that a RemoteCall command can only call an executable program, not a GNT file.

Syntax and Parameters

This example shows a sample RemoteCall function issued from an Application Engine PeopleCode action to a COBOL module:

```
RemoteCall ("PSRCCBL",?
  "PSCOBOLPROG", "PTPECOBL",?
  "AECOBOLPROG", "MY_GNT",?
  "STATERECORD", "MY_AET",?
  "PRCSINST", MY_AET.PROCESS_INSTANCE,?
  "RETCODE", &RC,?
  "ERRMSG", &ERR_MSG,?
  "FIELD1", MY_AET.FIELD1,?
  "FIELD2", MY_AET.FIELD2);
```

This table describes each parameter in the RemoteCall function:

Parameters	Description
PSRCCBL	The Remote Call dispatcher, which runs the specified COBOL program using the connect information of the current operator.
PSCOBOLPROG	Specify the name of the COBOL program to run, which in this case is PTPECOBL. This parameter makes the remote call from Application Engine distinct from a normal remote call. When you enter this parameter, in effect you enable the following parameters, some of which are required.
AECOBOLPROG	Specify the name of the COBOL module you are calling; for example, MY_GNT.
STATERECORD	Specify the appropriate state record that your Application Engine program will share with your COBOL module; for example, MY_AET. PTPECOBL then reserves space in memory for all of the fields in the state record, regardless of whether they will ultimately store values for processing.
PRCSINST	Specify the state record and Process Instance field; for example, MY_AET.PROCESS_INSTANCE. This setting retrieves the current process instance value that appears on the state record and submits it to your COBOL module using PTPECOBL.
RETCODE and ERRMSG	(Optional) Include RETCODE if you need to return information about any potential problems that the COBOL processing encountered, or use it if your Application Engine program must know whether it completed successfully.
Fieldnames and Values	Specify any fields in the state record that contain initial values for your COBOL module. The quoted field names you specify must exist in the specified state record. The corresponding value can be a PeopleCode variable, a record.field reference, or a hard-coded value.

Commit and RemoteCall

When using RemoteCall and an Application Engine program:

- The called COBOL module runs as a separate unit of work.
- Run a commit in the step immediately preceding the step containing the RemoteCall PeopleCode action and also in the step containing the Remote Call PeopleCode action.

These two actions enable the COBOL process to recognize the data changes made up to the point that it was called, and minimizes the time when the process might be in a non-restartable state.

- If you insert SQL processing into your COBOL module, your module makes commit updates.
PTPECOBL does not issue any commits.
- If the intent of your COBOL process is to update the value of a passed state record field, then the calling Application Engine PeopleCode is responsible for ensuring that the state record field is modified, and the Application Engine program is responsible for committing the state record updates.
- Consider how your COBOL module will react in the event of a restart.

Because the work in COBOL will have already completed and been committed, will your module ignore a duplicate call or be able to undo or redo the work multiple times? You face similar issues when you run a remote call from PeopleCode.

- Typically, when a COBOL program updates the database and then disconnects or terminates without having issued an explicit commit or rollback, an implicit rollback occurs.

Without an explicit commit, the database does not retain any updates.

Note. By default, RemoteCall does not generate any log files after the program completes. To generate and retain the .out and .err log files, you must set the *RCCBL Redirect* parameter in the PeopleSoft Process Scheduler configuration file to a value of *1*.

See *PeopleTools 8.52: PeopleCode Language Reference*, "PeopleCode Built-in Functions," SetNextPanel.

See Also

PeopleTools 8.52: PeopleSoft Process Scheduler, "Using the PSADMIN Utility," Editing the PeopleSoft Process Scheduler Configuration File

Calling PeopleTools APIs

You can call all of the PeopleTools APIs from an Application Engine program. When using APIs, remember that:

- All the PeopleTools APIs contain a Save method.

However, when you call an API from your Application Engine program, regardless of the Save method of the API, the data is not saved until the Application Engine program issues a commit.

- If you called a component interface from an Application Engine program, all the errors related to the API are logged in the PSMMessage collection associated with the current session object.
- If you sent a message, errors are written to the message log and the Application Engine message log.
- If an Application Engine program called from a message subscription PeopleCode encounters errors and the program exits (with `Exit (1)`), the error is written to the message log and is marked as an error

Using the CommitWork Function

This function commits pending changes (inserts, updates, and deletes) to the database. When using CommitWork, remember that:

- This function applies only to a batch Application Engine program.

If the program is invoked by CallAppEngine, the CommitWork function is ignored. The same is true for commit settings at the section or step levels.

- This function can be used only in an Application Engine program that has restart disabled.
- The CommitWork function is useful only when you are processing SQL one row at a time in a single PeopleCode program, and you need to commit without exiting the program.

In a typical Application Engine program, SQL commands are split between multiple Application Engine actions that fetch, insert, update, or delete application data. You use the section or step level commit settings to manage the commits.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "PeopleCode Built-in Functions," CommitWork

Calling WINWORD Mail Merge

If the Process Scheduler is booted using a shared drive on another machine and you intend to call a WINWORD mail merge process from Application Engine, then you must do one of the following to ensure successful completion:

1. Configure the Process Scheduler to run Application Engine programs using psae instead of psaesrv.
2. Ensure the generated document is saved locally, not on a shared network drive.

Using PeopleCode Examples

The following topics provide examples of common ways that you can use PeopleCode within Application Engine programs.

Do When Actions

Instead of a Do When action that checks a %BIND value, you can use PeopleCode to perform the equivalent operation. For example, suppose the following SQL exists in your program:

```
%SELECT(EXISTS) SELECT 'Y' FROM PS_INSTALLATION WHERE %BIND(TYPE) = 'X' ,
```

Using PeopleCode, you could insert this code:

```
If TYPE = 'X' Then
    Exit(0);
Else
    Exit(1);
End-if;
```

If you set the On Return parameter on the PeopleCode action properties to *Skip Step*, this code behaves the same as the Do When action. The advantage of using PeopleCode is that no trip to the database occurs.

Dynamic SQL

If you have a Select statement that populates a text field with dynamic SQL, such as the following:

```
%SELECT(AE_WHERE1)
SELECT 'AND ACCOUNTING_DT <= %Bind(ASOF_DATE)'
```

You can use this PeopleCode:

```
AE_WHERE1 = "AND ACCOUNTING_DT <= %Bind(ASOF_DATE)";
```

Sequence Numbering

If you typically use Select statements to increment a sequence number inside of a Do Select, While, or Until loop, you can use the following PeopleCode instead:

```
SEQ_NBR = SEQ_NBR + 1;
```

Using PeopleCode rather than SQL can affect performance significantly. Because the sequencing task occurs repeatedly inside a loop, the cost of using a SQL statement to increment the counter increases with the volume of transactions your program processes. When you are modifying a program to take advantage of PeopleCode, the areas of logic you should consider are those that start with steps that run inside a loop.

Note. You can also use the meta-SQL constructs %Next and %Previous when performing sequence numbering. These constructs may improve performance in both PeopleCode and SQL calls.

Rowsets

You can use rowsets in Application Engine PeopleCode; however, using rowsets means you will be using PeopleCode to handle more complicated processing, which degrades performance.

Math Functions

Use the math functions that your database offers whenever possible.

Internally, PeopleCode assigns types to numeric values. Calculations for the Decimal type are processed in arrays to ensure decimal point uniformity across hardware and operating system environments. This processing is much slower than calculations for type Integer, which are processed at the hardware level.

When PeopleCode converts strings to numeric values, it does so using the internal Decimal type. For performance reasons, avoid calculations using these values.

A third type of numeric value is the Float type. It is not used as frequently for the following reasons:

- Constants are never stored as Float types in the compiled code.
For example, 2.5 is always Decimal type.
- The only way to produce a Float value is by using built-in functions, such as Float or the Financial math functions.

Use the Float type to produce a float result only if all operands are also of the Float type. Float operations occur at the hardware level.

PeopleCode does not offer optimum performance when processing non-Integer, non-Float math calculations. To perform calculations with these numeric types, consider allowing the database to perform the calculations in COBOL.

PeopleCode supports a range of mathematical functions and numeric types. In general, if a complex calculation is run repetitively in an Application Engine program, you should carefully analyze whether to perform the calculation in a PeopleCode action or use the relational database management system (RDBMS) functions through a SQL action. Using SQL may require PeopleSoft meta-SQL to handle platform differences, but it may be the most efficient way to update field values. If SQL is not appropriate, consider numeric typing in PeopleCode, as it affects the speed and accuracy of the calculation.

SQL Class

Instead of using the SQL class within PeopleCode, have Application Engine issue the SQL and use a Do Select action that loops around sections containing PeopleCode actions.

Coding all of the logic within a single PeopleCode program might appear to be easier, but splitting the logic into smaller pieces is preferable because you will have better performance and will get more detailed commit control. Within a PeopleCode program, you can commit in certain cases using the CommitWork function. You can always issue a commit between Application Engine steps.

See *PeopleTools 8.52: PeopleCode Language Reference*, "PeopleCode Built-in Functions," CommitWork.

See *PeopleTools 8.52: PeopleCode API Reference*, "SQL Class," Understanding SQL Objects and Application Engine Programs.

Arrays

Instead of using arrays in Application Engine PeopleCode, explore the use of temporary tables for storing pertinent or affected data. Arrays offer the following advantages:

- Data is available for restarts.
- An RDBMS is efficient at managing and searching tables.
- Temporary tables lend themselves to set-based processing.

You can use the Statement Timings and PeopleCode Detail Timings trace options to generate an Application Engine timings report to determine whether your program is spending significant time processing arrays.

Including Dynamic SQL

Typically, developers include dynamic constructs in Application Engine programs to change SQL based on various runtime factors or on user-defined entries on a page. You can include dynamic SQL in Application Engine programs in a variety of ways. For example, you can:

- Include dynamic sections using the AERSection object.
- Change SQL using the SQL class.
- Reference SQL in your own tables.

The AERSection class is designed primarily for online section building; therefore, it will not be the most frequently used solution.

Use the SQL class to store SQL in a SQL definition that you can also access in Application Designer. Then, if you have a few SQL statements to run, generate the SQL IDs based on some methodology, such as a timestamp, and then store these in a table.

When the program runs, your SQL could query this table based on process and extract the appropriate SQL IDs to be run with a SQL action in a Do Select loop.

```
%SQL( %BIND( MY_SQLID , NOQUOTES ) )
```

For a dynamic Do action, the AE_APPLID and the AE_SECTION fields must appear in the default state record.

Using Application Engine Meta-SQL

This section describes the meta-SQL constructs, functions, and meta-variables you can use in Application Engine.

Note. The SQL Editor does not validate all of the meta-SQL constructs, such as %Bind and %Select. Messages might appear stating that these constructs are invalid.

%Abs

Description

Because the %Abs function can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %Abs

%AeProgram

Description

Use the %AeProgram meta-variable to specify a quoted string containing the currently running Application Engine program name.

%AeSection

Description

Use the %AeSection meta-variable to specify a quoted string containing the currently running Application Engine section name.

%AeStep

Description

Use the %AeStep meta-variable to specify a quoted string containing the currently running Application Engine Step name.

%AsOfDate

Description

Use the %AsOfDate meta-variable to specify a quoted string containing the as of date used for the current process.

%AsOfDateOvr

Description

Use the %AsOfDateOvr meta-variable only as a parameter of the %ExecuteEdits function to override the default use of the system date with the value of a field on a joined record.

See Also

[Chapter 5, "Using Meta-SQL and PeopleCode," %Table, page 109](#)

%BINARYSORT

Description

Because the %BINARYSORT construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %BINARYSORT

%Bind**Syntax**

```
%Bind([recordname.]fieldname [, NOQUOTES][, NOWRAP][, STATIC])
```

Description

Use the %Bind construct to retrieve a field value from a state record. You can use %Bind anywhere in a SQL statement. When run, %Bind returns the value of the state record field identified within its parentheses.

Notes About %Bind

Typically, when you use %Bind to provide a value for a field or a Where condition, the type of field in the state record that you reference with %Bind must match the field type of the corresponding database field used in the SQL statement.

On most platforms, you cannot use a literal to populate a Long Varchar field. You should use the %Bind (*recordname.fieldname*) construct.

In the case of an external call to a section in another program, if the called program has its own default state record defined, then Application Engine uses that default state record to resolve the %Bind(*fieldname*). Otherwise, the called program inherits the default state record of the calling program.

All fields referenced by a %Select construct must be defined in the associated state record.

You must use the Date, Time, and DateTime output wrappers in the Select list that populates the state record fields to ensure compatibility across all supported database platforms.

For example:

- First SQL Action

```
%Select (date_end)
  SELECT %DateOut (date_end )
    FROM PS_EXAMPLE
```

- Second SQL Action

```
INSERT INTO PS_EXAMPLE
  VALUES (%Bind (date_end))
```

Bind Variables and Date Wraps

The behavior of bind variables within Application Engine PeopleCode and normal PeopleCode is the same.

If you compare Application Engine SQL to PeopleCode (of any type), then the system processes bind variables differently.

If you use the following approach:

```
AND TL_EMPL_DATA1.EFFDT <= %P(1)
```

Then in PeopleCode you issue

```
%SQL(MY_SQL, %DateIn(:1))
```

which assumes that you referenced the literal as a bind variable.

Or in Application Engine SQL, you issue

```
%SQL(MY_SQL, %Bind(date_field))
%SQL(MY_SQL, %Bind(date_field, NOWRAP))
```

Parameters

Parameter	Description
<i>Recordname</i>	The name of a state record. If you do not specify a particular state record, Application Engine uses the default state record to resolve the %Bind (<i>fieldname</i>).
<i>Fieldname</i>	The field defined in the state record.
NOQUOTES	If the field specified is a character field, its value is automatically enclosed in quotes unless you use the NOQUOTES parameter. Use NOQUOTES to include a dynamic table and field name reference, even an entire SQL statement or clause, in an Application Engine SQL action.
NOWRAP	If the field is of type Date, Time, or DateTime, the system automatically wraps its value in %DateIn or %DateOut, unless you use the NOWRAP parameter. Therefore, if the state record field is populated correctly, you do not need to be concerned with the inbound references, although you can suppress the inbound wrapping with the NOWRAP modifier inside the %Bind. Furthermore, Application Engine skips the inbound wrapper if the %Bind (<i>date</i>) is in the select field list of another %Select statement. This is because the bind value is already in the outbound format, and the system selects it into another state record field in memory. In this circumstance there is no need for either an outbound wrapper or an inbound wrapper. For example, First SQL action: %Select(date_end) SELECT %DateOut(date_end) FROM PS_GREG Second SQL action: INSERT INTO ps_greg VALUES(%Bind(date_end))
STATIC	The STATIC parameter enables you to include a hard-coded value in a reused statement. For %Bind instances that contain dynamic SQL, this parameter must be used in conjunction with the NOQUOTES parameter for proper execution of a reused statement.

Example

```
UPDATE PS_REQ_HDR
  SET IN_PROCESS_FLG = %Bind(MY_AET.IN_PROCESS_FLG) ,
      PROCESS_INSTANCE = %Bind(PROCESS_INSTANCE)
  WHERE IN_PROCESS_FLG = 'N'
      AND BUSINESS_UNIT || REQ_ID
      IN (SELECT BUSINESS_UNIT || REQ_ID
          FROM PS_PO_REQRCON_WK1
          WHERE PROCESS_INSTANCE = %Bind(PROCESS_INSTANCE))
```

In the previous example, %Bind (PROCESS_INSTANCE) assigns the value of the field PROCESS_INSTANCE in the default state record to the PROCESS_INSTANCE field in table PS_REQ_HDR.

The %Bind construct is also used in a Where clause to identify rows in the table PS_PO_REQRCON_WK1, in which the value of PROCESS_INSTANCE equals the value of PROCESS_INSTANCE in the default state record.

%Cast

Description

Because the %Cast function can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %Cast

%ClearCursor

Syntax

```
%ClearCursor({program,section,step, action | ALL})
```

Description

Use the %ClearCursor function to recompile a reused statement and reset any STATIC %Bind variables.

When you use the %ClearCursor function, remember that:

- The function must be located at the beginning of the statement.
- %ClearCursor can be the only function or command contained in the statement.

Parameters

<i>Parameter</i>	<i>Description</i>
<i>program</i>	Specify the name of the Application Engine program containing the reused statement you want to recompile.
<i>section</i>	Specify the name of the section containing the reused statement you want to recompile.
<i>step</i>	Specify the name of the step containing the reused statement you want to recompile.
<i>action</i>	Specify one of the following values: <ul style="list-style-type: none"> • D: Do Select. • H: Do When. • N: Do Until. • W: Do While. • S: SQL.
ALL	Clear all cursors in the current Application Engine program.

%COALESCE

Description

Because the %COALESCE function can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %COALESCE

%Comma

Description

Use the %Comma meta-variable to specify a comma. This meta-variable is useful when you must use a comma but commas are not allowed because of parsing rules. For example, you might use this meta-variable if you want to pass a comma as a parameter to the %SQL meta-SQL function.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %SQL

%Concat**Description**

Because the %Concat meta-variable can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %Concat

%CurrentDateIn**Description**

Because the %CurrentDateIn meta-variable can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %CurrentDateIn

%CurrentDateOut**Description**

Because the %CurrentDateOut meta-variable can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %CurrentDateOut

%CurrentDateTimeIn

Description

Because the %CurrentDateTimeIn meta-variable can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %CurrentDateTimeIn

%CurrentDateTimeOut

Description

Because the %CurrentDateTimeOut meta-variable can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %CurrentDateTimeOut

%CurrentTimeIn

Description

Because the %CurrentTimeIn meta-variable can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %CurrentTimeIn

%CurrentTimeOut

Description

Because the %CurrentTimeOut meta-variable can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %CurrentTimeOut

%DateAdd**Description**

Because the %DateAdd function can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %DateAdd

%DateDiff**Description**

Because the %DateDiff function can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %DateDiff

%DateIn**Description**

Because the %DateIn construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %DateIn

%DateNull

Description

Because the %DateNull meta-variable can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %DateNull

%DateOut

Description

Because the %DateOut function can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %DateOut

%DatePart

Description

Because the %DatePart function can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %DatePart

%DateTimeDiff

Description

Because the %DateTimeDiff function can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %DateTimeDiff

%DateTimeIn

Description

Because the %DateTimeIn construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %DateTimeIn

%DateTimeNull

Description

Because the %DateTimeNull meta-variable can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %DateTimeNull

%DateTimeOut

Description

Because the %DateTimeOut function can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %DateTimeOut

%DecDiv

Description

Because the %DecDiv function can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %DecDiv

%DecMult

Description

Because the %DecMult function can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %DecMult

%Delete

Description

Because the %Delete shortcut can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

Note. This meta-SQL can only be used in PeopleCode programs, not in Application Engine SQL actions.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %Delete

%DTTM

Description

Because the %DTTM function can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %DTTM

%EffDtCheck

Description

Because the %EffDtCheck construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %EffDtCheck

%Execute

Syntax

```
%Execute ( [ / ] )
command1 { ; | / }
command2 { ; | / } . . .
commandN { ; | / }
```

Description

Use the %Execute function to execute database-specific commands from within your Application Engine program. Also, the %Execute function enables you to include multiple statements in a single Application Engine action without encountering database-specific differences. For instance, in some instances you could code a single Application Engine action to contain multiple SQL statements, and they might run successfully on one database platform. However, if you attempt to run the same code against a different database platform, you might encounter errors or skipped SQL.

By default, Application Engine expects a semicolon to be used to delimit multiple commands within an %Execute function statement. You can instruct Application Engine to use a forward slash (/) delimiter instead by placing a forward slash inside the function parentheses.

Note. When you use the %Execute function, it must be located at the beginning of the statement and must be the only function or command contained in the statement. The action type must be SQL.

Example

The following code enables you to use an Oracle PL/SQL block in an %Execute statement:

```
%Execute(/)
DECLARE
  counter INTEGER;
BEGIN
  FOR counter := 1 TO 10
    UPDATE pslock SET version = version + 1;
  END FOR;
END;
/
```

%ExecuteEdits

Syntax

```
%ExecuteEdits(type,recordname [alias][, field1,field2, ...])
```

Description

Use the %ExecuteEdits function to apply data dictionary edits in batch. The %ExecuteEdits function is Application Engine-only meta-SQL. You cannot use it in COBOL, SQR, or PeopleCode, not even in Application Engine PeopleCode.

Notes About %ExecuteEdits

Note the following points about the %ExecuteEdits function:

- Consider performance carefully when using this function.

Prompt table and Translate table edits have a significant effect because they involve correlated subqueries. Run a SQL trace at runtime so that you can view the SQL generated by %ExecuteEdits. Look for opportunities to optimize it.

- In general, %ExecuteEdits is best used on a temporary table.

If you must run it against a real application table, you should provide Where clause conditions to limit the number of rows to include only those that the program is currently processing. Process the rows in the current set at one time rather than row by row.

- With %ExecuteEdits, you cannot use work records in a batch, set-based operation.

All higher-order key fields used by prompt table edits must exist in the record that your code intends to edit, and the field names must match exactly. For example,

```
%ExecuteEdits(%Edit_PromptTable, MY_DATA_TMP)
```

The record MY_DATA_TMP contains the field STATE with a prompt table edit against PS_REGION_VW, which has key fields COUNTRY and REGION. The REGION field corresponds to STATE, and COUNTRY is the higher-order key. For %ExecuteEdits to work correctly, the MY_DATA_TMP record must contain a field called COUNTRY. The edited field (STATE) can use a different name because Application Engine always references the last key field (ignoring EFFDT).

- In Application Engine, %ExecuteEdits uses the system date when performing comparisons with effective date (EFFDT); however, in some cases this date is not appropriate (Journal Edit, Journal Import, and so on). In these situations, use Journal Date when comparing with EFFDT. To override the use of the default system date with a selected field from a joined table, use %AsOfDateOvr. For example,

```
%ExecuteEdits(%AsOfDateOvr(alias.fieldname), %Bind(...))
```

- Restrict the number and type of edits to the minimum required.

Do not edit fields that are known to be valid or that are given default values later in the process. Also consider using a separate record with edits defined specifically for batch or provide a list of fields to be edited.

Parameters

Parameter	Description
<i>type</i>	Specify any combination of the following (added together): <ul style="list-style-type: none"> • %Edit_Required • %Edit_YesNo • %Edit_DateRange • %Edit_PromptTable • %Edit_TranslateTable
<i>recordname</i>	Specify the record used to obtain the data dictionary edits.
<i>field1, field2, ...</i>	Specify a subset of the fields of the record to which edits apply.

Example

Suppose you want to insert rows with missing or invalid values in three specific fields, selecting data from a temporary table but using edits defined on the original application table. Notice the use of an alias, or correlation name, inside the meta-SQL:

```

INSERT INTO PS_JRNL_LINE_ERROR (...)
SELECT ... FROM PS_JRNL_LINE_TMP A
WHERE A.PROCESS_INSTANCE = %BIND(PROCESS_INSTANCE)
      AND %EXECUTEEDITS(%Edit_Required + %Edit_PromptTable,?
      JRNL_LINE A, BUSINESS_UNIT, JOURNAL_ID, ACCOUNTING_DT)

```

To update rows that have some kind of edit error in a temporary table, you can use custom edits defined in the temporary table record:

```

UPDATE PS_PENDITEM_TAO
SELECT ERROR_FLAG = 'Y'
WHERE PROCESS_INSTANCE = %BIND(PROCESS_INSTANCE)
      AND %EXECUTEEDITS(%Edit_Required + %Edit_YesNo + %Edit_DateRange +?
      %Edit_PromptTable + %Edit_TranslateTable, PENDITEM_TAO)

```

%FirstRows

Description

Because the %FirstRows meta-variable can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %FirstRows

%GetProgText

Syntax

```
%GetProgText (&Prog, &Section, &Market, &Platform, &Effdt, &Step, &Event)
```

Description

The %GetProgText function returns a string with the text of a PeopleCode program uniquely identified by the parameters.

Parameters

<i>Parameter</i>	<i>Description</i>
<i>&Prog</i>	A string with the name of an Application Engine program.
<i>&Section</i>	A string with the name of an Application Engine program section.
<i>&Market</i>	A string specifying the market for an Application Engine program section.

Parameter	Description
<i>&Platform</i>	A string specifying the platform for an Application Engine program section.
<i>&Effdt</i>	A string specifying the effective date for an Application Engine program section.
<i>&Step</i>	A string specifying a step in an Application Engine program section.
<i>&Event</i>	A string specifying the PeopleCode event.

Returns

A string containing the text of a PeopleCode program.

Example

```
&PeopleCodeText = GetProgText("DYNROLE_PUBL", "MAIN", "GBL", "default",
"1900-01-01", "Step03", "OnExecute");
```

See Also

PeopleTools 8.52: PeopleCode Developer's Guide, "Using the SQL Editor"

%Insert

Description

Because the %Insert shortcut can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

Note. This meta-SQL can only be used in PeopleCode programs, not in Application Engine SQL actions.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %Insert

%InsertSelect

Description

Because the %InsertSelect construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %InsertSelect

%InsertSelectWithLongs

Description

Because the %InsertSelectWithLongs construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %InsertSelectWithLongs

%InsertValues

Description

Because the %InsertValues construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

Note. This meta-SQL can only be used in PeopleCode programs, not in Application Engine SQL actions.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %InsertValues

%JobInstance

Description

Use the %JobInstance meta-variable to specify the numeric (unquoted) PeopleSoft Process Scheduler job instance.

%Join

Description

Because the %Join construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %Join

%KeyEqual

Description

Because the %KeyEqual construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

Note. This meta-SQL can only be used in PeopleCode programs, not in Application Engine SQL actions.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %KeyEqual

%KeyEqualNoEffDt

Description

Because the %KeyEqualNoEffDt construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

Note. This meta-SQL can only be used in PeopleCode programs, not in Application Engine SQL actions.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %KeyEqualNoEffDt

%LeftParen

Description

Use the %LeftParen meta-variable to specify a left parenthesis. Usage is similar to %Comma.

See Also

[Chapter 5, "Using Meta-SQL and PeopleCode," %Comma, page 79](#)

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %SQL

%Like

Description

Because the %Like construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %Like

%LikeExact

Description

Because the %LikeExact construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %LikeExact

%List

Syntax

```
%List( {FIELD_LIST | FIELD_LIST_NOLONGS | KEY_FIELDS | ORDER_BY}, recordname [ correlation_id ] )
```

Description

The %List construct expands into a list of field names delimited by commas. The fields included in the expanded list depend on the parameters.

Note. This meta-SQL is not implemented for COBOL, dynamic view SQL, or PeopleCode.

Considerations for Using %List

When using %List in an Insert/Select or Insert/Values or %Select statement, you must have matching pairs of %List (or %ListBind) variables in the target and source field lists. Use the same list type argument and record name to ensure consistency.

Parameters

<i>Parameter</i>	<i>Description</i>
FIELD_LIST	Use all field names in the given record. You can select only one option from FIELD_LIST, ORDER_BY, FIELD_LIST_NOLONGS, or KEY_FIELDS.
KEY_FIELDS	Use all key fields in the given record. You can select only one option from FIELD_LIST, FIELD_LIST_NOLONGS, KEY_FIELDS, or ORDER_BY.
ORDER_BY	Use all the key fields of <i>recordname</i> , adding the DESC field for descending key columns. This parameter is often used when the list being generated is for an Order By clause. You can select only one option from FIELD_LIST, KEY_FIELDS, ORDER_BY, or FIELD_LIST_NOLONGS.
FIELD_LIST_NOLONGS	Use all field names in the given record, except any long columns (long text or image fields.) You can select only one option from FIELD_LIST, ORDER_BY, KEY_FIELDS, or FIELD_LIST_NOLONGS.
<i>recordname</i>	Identify either a record or a subrecord that the field names are drawn from. This can be a bind variable, a record object, or a record name in the form <i>recname</i> . You cannot specify RECORD. <i>recname</i> , a record name in quotation marks, or a table name.
<i>correlation_id</i>	Identify the single-letter correlation ID to relate the record specified by <i>recordname</i> and its fields.

Example

The following is a good example of using %List. Both the Insert and Select statements use the same %List variable:

```

INSERT INTO PS_PO_DISTRIB_STG ( %Sql(POCOMMONDISTSTGFLLDLSTU)
, %List(FIELD_LIST, CF16_AN_SBR)
, MERCHANDISE_AMT
, MERCH_AMT_BSE
, QTY_DEMAND
, QTY_PO
, QTY_PO_STD
, QTY_REQ)
SELECT %Sql(POCOMMONDISTSTGFLLDLSTU)
, %List(FIELD_LIST, CF16_AN_SBR)
, MERCHANDISE_AMT
, MERCH_AMT_BSE
, QTY_DEMAND
, QTY_PO
, QTY_PO_STD
, QTY_REQ
FROM PS_PO_DIST_STG_WRK WRK
WHERE WRK.PROCESS_INSTANCE = %Bind(PROCESS_INSTANCE)

```

The following example shows a poor example of how to use %List. The Insert and Select field lists both use %List, but the Select field list is only partly dynamic; the rest is hard-coded.

```

INSERT INTO PS_EN_TRN_CMP_TMP (%List(FIELD_LIST, EN_TRN_CMP_TMP))
SELECT B.EIP_CTL_ID
, %List(SELECT_LIST, EN_BOM_COMPS A)
, E.COPY_DIRECTION
, E.BUSINESS_UNIT_TO
, E.BOM_TRANSFER_STAT
, 'N'
, B.MASS_MAINT_CODE
, 0
FROM PS_EN_BOM_COMPS A
, PS_EN_ASSY_TRN_TMP B
, PS_EN_TRNS_TMP E
WHERE ...

```

The following example shows the previous poor example rewritten in a better way:

```

INSERT INTO PS_EN_TRN_CMP_TMP (EIP_CTL_ID,
, %List(FIELD_LIST, EN_BOM_COMPS)
, COPY_DIRECTION
, BUSINESS_UNIT_TO
, BOM_TRANSFER_STAT
, EN_MMC_UPDATE_FLG
, MASS_MAINT_CODE
, EN_MMC_SEQ_FLG01
, ...
, EN_MMC_SEQ_FLG20)
SELECT B.EIP_CTL_ID
, %List(FIELD_LIST, EN_BOM_COMPS A)
, E.COPY_DIRECTION
, E.BUSINESS_UNIT_TO
, E.BOM_TRANSFER_STAT
, 'N'
, B.MASS_MAINT_CODE
, 0
, ...
, 0
FROM PS_EN_BOM_COMPS A
, PS_EN_ASSY_TRN_TMP B
, PS_EN_TRNS_TMP E
WHERE ...

```

The following code segment is another poor example. Only the field list of the Insert statement is dynamically generated, and the Select statement is statically coded. If the table STL_NET_TBL is reordered, the Insert statement will be incorrect.

```
INSERT INTO PS_STL_NET_TBL (%List(FIELD_LIST, STL_NET_TBL ) )
SELECT :1
, :2
, :3
, :4
, :5
, :6
, :7
,:8
FROM PS_INSTALLATION
```

The following code shows the previous poor example rewritten in a better way:

```
INSERT INTO PS_STL_NET_TBL (%List(FIELD_LIST, STL_NET_TBL))
VALUES (%List(BIND_LIST, STL_NET_TBL MY_AET))
```

%ListBind

Syntax

```
%ListBind({FIELD_LIST | FIELD_LIST_NOLONGS | KEY_FIELDS}, recordname [
State_record_alias])
```

Description

The %ListBind meta-SQL construct expands a field list as bind references for use in an Insert/Value statement.

Note. This meta-SQL is not implemented for COBOL, dynamic view SQL, or PeopleCode.

Considerations for Using %ListBind

When using %ListBind in an insert/select or insert/values or %Select statement, you must have matching pairs of %List or %ListBind in the target and source field lists, using the same list type argument and record name to ensure consistency.

Parameters

<i>Parameter</i>	<i>Description</i>
FIELD_LIST	Use all field names in a record. You can select only one option from FIELD_LIST, FIELD_LIST_NOLONGS, or KEY_FIELDS.
FIELD_LIST_NOLONGS	Use all field names in a record, except any long columns (long text or image fields). You can select only one option from FIELD_LIST, FIELD_LIST_NOLONGS, or KEY_FIELDS.

<i>Parameter</i>	<i>Description</i>
KEY_FIELDS	Use all key field names in a record. You can select only one option from FIELD_LIST, FIELD_LIST_NOLONGS, or KEY_FIELDS.
<i>recordname</i>	Identify either a record or a subrecord that the field names are drawn from. This can be a bind variable, a record object, or a record name in the form <i>recname</i> . You cannot specify RECORD. <i>recname</i> , a record name in quotation marks, or a table name.
<i>State_record_alias</i>	Specify the Application Engine state record buffer that contains the values (this could be different than the record used to derive the field list). If missing, the default state record is assumed.

Example

```
INSERT INTO PS_TARGET (FIELD1, FIELD2, %List(FIELD_LIST, CF_SUBREC), FIELDN)⇒
VALUES (%Bind(MY_AET.FIELD1), %Bind(MY_AET.FIELD2), %ListBind(FIELD_LIST, CF_⇒
SUBREC MY_AET), %Bind(MY_AET.FIELDN))
```

%ListEqual

Syntax

```
%ListEqual({ALL | KEY }, Recordname [alias], RecordBuffer [, Separator])
```

Description

The %ListEqual construct maps each field, possibly to an alias with a %Bind value, with a separator added before each equality. Each field is mapped as follows:

```
alias.X = %Bind(recbuffer.X)
```

This construct can be used in the Set clause of an Update statement or in a Where clause.

Note. This meta-SQL is not implemented for COBOL, dynamic view SQL, or PeopleCode.

Parameters

<i>Parameter</i>	<i>Description</i>
ALL KEY	Specify if you want all fields or just key fields.
<i>recordname</i>	Identify either a record or a subrecord that the field names are drawn from. This can be a bind variable, a record object, or a record name in the form <i>recname</i> . You cannot specify RECORD. <i>recname</i> , a record name in quotation marks, or a table name.

Parameter	Description
<i>alias</i>	(Optional) Specify an alias to precede each field name.
<i>RecordBuffer</i>	Specify the record buffer for the bind variables (this could be different than the record used to derive the field list).
<i>Separator</i>	If you want to specify a logical separator, specify either AND or OR with this parameter. If you do not specify a separator, no logical separator is used; the value of a comma is used instead.

Example

```
UPDATE PS_TEMP

SET %ListEqual(ALL, CF_SUBREC, MY_AET)
WHERE %ListEqual(KEYS, TEMP, MY_AET, AND)
```

%Mod

Description

Because the %Mod function can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %Mod

%Next and %Previous

Description

Use the %Next and %Previous functions to return the value of the next or previous field in a numbered sequence. These functions are valid in any Application Engine SQL action and should be used when performing sequence-numbering processing. Typically, you use them instead of a %Bind construct. These functions use the current value of the number field as a bind variable and then increment (%Next) or decrement (%Previous) the value after the statement runs successfully. A number field indicates the numeric field of the state record that you initially set to a particular value (as in 1 to start).

If the statement is a Select and no rows are returned, the field value is not changed. The substitution rules are the same as for %Bind. For example, if the ReUse property is enabled, then the field is a true bind (:n substituted). Otherwise, inline substitution occurs.

Example

You could use these functions in an Update statement within a Do Select action:

- Do Select action

```
%SELECT(field1, field2, ...) SELECT key1, key2, ... FROM PS_TABLE WHERE ...
ORDER BY key1, key2, ..."
```

- SQL

```
UPDATE PS_TABLE SET SEQ_NBR = %Next(seq_field) WHERE key1 = %Bind(field1)
AND key2 = %Bind(field2) ...
```

With a Do Select action, the increment/decrement occurs once per run, not once for every fetch. So unless your Do Select action implements the Reselect property, the value is changed only on the first iteration of the loop. Alternatively, with the Reselect property or Do While and Do Until actions, every iteration reruns the Select statement and then fetches one row. With these types of loops, the value changes on every iteration.

See Also

[Chapter 5, "Using Meta-SQL and PeopleCode," %Bind, page 76](#)

%NoUpperCase

Description

Because the %NoUpperCase construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %NoUppercase

%NumToChar

Description

Because the %NumToChar construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %NumToChar

%OldKeyEqual

Description

Because the %OldKeyEqual construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

Note. This meta-SQL can only be used in PeopleCode programs, not in Application Engine SQL actions.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %OldKeyEqual

%ProcessInstance

Description

Use the %ProcessInstance meta-variable to specify the numeric (unquoted) process instance.

%ResolveMetaSQL

Syntax

```
%ResolveMetaSQL( &SQL , %DbType )
```

Description

The %ResolveMetaSQL function returns a string with any meta-SQL in the string expanded to platform-specific SQL, similar to the text that is returned on the Meta-SQL tab when using the Resolve Meta-SQL option in the SQL Editor.

If *&SQL* does not contain any meta-SQL, then the function returns a string identical to *&SQL*.

%DbType value represents the type of current database.

Parameters

<i>Parameter</i>	<i>Description</i>
<i>&SQL</i>	Specify a string containing the SQL to be resolved.

Parameter	Description
%DBType	%DBType value is DB2

For more information on valid values to %DBType:

See *PeopleTools 8.52: PeopleCode Language Reference*, "PeopleCode Built-in Functions," FetchSQL.

Returns

A string with meta-SQL expanded to platform-specific SQL.

Example

Here is an example:

```
&SQLText = FetchSQL(SQL.PTLT_CODE_MARKET);
&ResolveSQLText = ResolveMetaSQL(&SQLText,DB2);
```

Suppose &SQLText contains the following SQL:

```
INSERT INTO %Table(PTLT_ASSGN_TASK)(PTLT_FEATURE_CODE
, PTLT_TASK_CODE
, PORTAL_NAME
, PTLT_TASK_CODE2
, MENUNAME
, OBJECTOWNERID)
SELECT A.EOLT_FEATURE_CODE
, %Sql(PTLT_TASK_CODE, A.PNLGRPNAME, A.MARKET)
, 'EMPLOYEE'
, %Sql(PTLT_TASK_CODE, A.PNLGRPNAME, A.MARKET)
, A.MENUNAME
, ''
FROM %Table(EOLT_FEAT_COMP) A
, %Table(PTLT_TASK) B
, %Table(PTLT_TASK_LOAD) C
WHERE %Sql(PTLT_TASK_CODE, A.PNLGRPNAME, A.MARKET) = B.PTLT_TASK_CODE
AND B.PTLT_TASK_CODE = C.PTLT_TASK_CODE
AND B.PTLT_LOAD_METHOD = C.PTLT_LOAD_METHOD
AND A.MENUNAME <> ''
AND A.MENUNAME <> C.MENUNAME
AND NOT EXISTS (
SELECT 'X'
FROM %Table(PTLT_ASSGN_TASK) Z
WHERE Z.PTLT_FEATURE_CODE = A.EOLT_FEATURE_CODE
AND Z.PTLT_TASK_CODE = %Sql(PTLT_TASK_CODE, A.PNLGRPNAME, A.MARKET))
```

&ResolveSQLText would contain the following text (depending on your database platform):

```

INSERT INTO PS_PTLT_ASSGN_TASK (PTLT_FEATURE_CODE
, PTLT_TASK_CODE
, PORTAL_NAME
, PTLT_TASK_CODE2
, MENUNAME
, OBJECTOWNERID)
SELECT A.EOLT_FEATURE_CODE
, RTRIM(SUBSTR( A.PNLGRPNAME
,1
,18)) || '.' || A.MARKET
, 'EMPLOYEE'
, RTRIM(SUBSTR( A.PNLGRPNAME
,1
,18)) || '.' || A.MARKET
, A.MENUNAME
, ''
FROM PS_EOLT_FEAT_COMP A
, PS_PTLT_TASK B
, PS_PTLT_TASK_LOAD C
WHERE RTRIM(SUBSTR( A.PNLGRPNAME,1,18)) || '.' || A.MARKET = B.PTLT_TASK_CODE
AND B.PTLT_TASK_CODE = C.PTLT_TASK_CODE
AND B.PTLT_LOAD_METHOD = C.PTLT_LOAD_METHOD
AND A.MENUNAME <> ''
AND A.MENUNAME <> C.MENUNAME
AND NOT EXISTS (
SELECT 'X'
FROM PS_PTLT_ASSGN_TASK Z
WHERE Z.PTLT_FEATURE_CODE = A.EOLT_FEATURE_CODE
AND Z.PTLT_TASK_CODE = RTRIM(SUBSTR( A.PNLGRPNAME,1,18)) || '.' || A.MARKET)

```

See Also

PeopleTools 8.52: PeopleCode Developer's Guide, "Using the SQL Editor"

%ReturnCode

Description

Use the %ReturnCode meta-variable to evaluate or specify the return code of the last Application Engine program step performed. If the operation fails, breaks, or generates an error, %ReturnCode is set to one of the following types of return codes:

- Database (SQL) call errors.
- PeopleCode function errors.
- GEN_ERROR, when produced by general runtime exceptions.
- AE_ABORT, when produced by application or runtime logic, including some memory-related errors.

If the application process is not terminated, %ReturnCode is reset to the default value of 0 for each subsequent successful operation.

%RightParen

Description

Use the %RightParen meta-variable to specify a right parenthesis. Usage is similar to that of %Comma.

See Also

[Chapter 5, "Using Meta-SQL and PeopleCode," %Comma, page 79](#)

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %SQL

%Round

Description

Because the %Round function can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %Round

%RoundCurrency

Syntax

```
%RoundCurrency( expression, [ALIAS.]currency_field)
```

Description

Use the %RoundCurrency function to return the value of an amount field rounded to the currency precision specified by the Currency Control Field property of the field, as defined in the Application Designer Record Field Properties dialog box. For this function to work, you must have the Multi-Currency option selected on the PeopleTools Options page.

See *PeopleTools 8.52: System and Server Administration*, "Using PeopleTools Utilities," Using Administration Utilities.

This function is an enhanced version of the Application Engine &ROUND construct that appeared in previous releases, and it is valid only in Application Engine SQL; it is not valid for SQLExecs or view text.

You can use this function in the Set clause of an Update statement or the Select list of an Insert/Select statement. The first parameter is an arbitrary expression of numeric values and columns from the source tables that computes the monetary amount to be rounded. The second parameter is the control currency field from a particular source table (the Update table, or a table in the From clause of an Insert/Select statement). This field identifies the corresponding currency value for the monetary amount.

Note. Remember that the as of date of the Application Engine program is used for obtaining the currency rounding factor. The currency rounding factor is determined by the value of DECIMAL_POSITIONS in the corresponding row in PS_CURRENCY_CD_TBL, which is an effective-dated table.

If multicurrency is not in effect, the result is rounded to the precision of the amount field (either 13.2 or 15.3 amount formats are possible).

Example

```
UPDATE PS_PENDING_DST
  SET MONETARY_AMOUNT =
    %RoundCurrency( FOREIGN_AMOUNT * CUR_EXCHNG_RT, CURRENCY_CD )
  WHERE GROUP_BU = %Bind(GROUP_BU) AND GROUP_ID = %Bind(GROUP_ID)
```

%RunControl

Description

Use the %RunControl meta-variable to specify a quoted string containing the current run control identifier. The run control ID is available to your program when using %RunControl, regardless of whether the AEREQUEST table contains a row.

%Select

Syntax

```
%Select(statefield1[, statefield2]...[, statefieldN])
Select field1[, field2]...[, fieldN]
```

The *statefields* must be valid fields on the state record (they may be fieldname or recordname.fieldname, as with %Bind), and *fields* must be either valid fields in the From tables or hard-coded values.

Description

Use the %Select construct to identify the state record fields to hold the values returned by the corresponding Select statement. The %Select construct is required at the beginning of all Select statements. For example, you need one in the flow control actions and one in the SQL actions that contain a Select statement.

You use the %Select construct to pass variables to the state record, and you use the %Bind construct to retrieve or reference the variables.

Example

Consider the following sample statement:

```
%SELECT ( BUSINESS_UNIT , CUST_ID )
SELECT BUSINESS_UNIT , CUST_ID
FROM PS_CUST_DATA
WHERE PROCESS_INSTANCE = %BIND ( PROCESS_INSTANCE )
```

The following steps illustrate the execution of the previous statement:

1. Resolve bind variables.

The string %Bind(PROCESS_INSTANCE) is replaced with the value of the state record field called PROCESS_INSTANCE.

2. Execute the SQL Select statement.
3. Perform a SQL Fetch statement.

If a row is returned, the state record fields BUSINESS_UNIT and CUST_ID are updated with the results. If the Fetch statement does not return any rows, all fields in the %Select construct retain their previous values.

Note. All fields referenced by a %Select construct must be defined in the associated state record. Also, aggregate functions always return a row, so they always cause the state record to be updated. As such, for aggregate functions, no difference exists between using %SelectInit or %Select.

%SelectAll

Description

Because the %SelectAll shortcut can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

Note. This meta-SQL can only be used in PeopleCode programs, not in Application Engine SQL actions.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %SelectAll

%SelectByKey

Description

Because the %SelectByKey shortcut can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

Note. This meta-SQL can only be used in PeopleCode programs, not in Application Engine SQL actions.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %SelectByKey

%SelectByKeyEffDt

Description

Because the %SelectByKeyEffDt shortcut can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*

Note. This meta-SQL can only be used in PeopleCode programs, not in Application Engine SQL actions.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %SelectByKeyEffDt

%SelectDistinct

Description

Because the %SelectDistinct shortcut can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

Note. This meta-SQL can only be used in PeopleCode programs, not in Application Engine SQL actions.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %SelectDistinct

%SelectInit

Syntax

```
%SelectInit(statefield1[, statefield2]...[, statefieldN])
```

```
Select field1[, field2]...[, fieldN]
```

The *statefields* must be valid fields on the state record (they may be fieldname or recordname.fieldname, as with %Bind), and *fields* must be either valid fields in the From tables or hard-coded values.

Description

Use the %SelectInit construct to identify the state record fields to hold the values returned by the corresponding Select statement.

The %SelectInit construct is identical to the %Select construct with the following exception: if the Select statement returns no rows, then %SelectInit re-initializes the buffers. In the case of a %Select construct where no rows are returned, the state record fields retain their previous values.

Note. For aggregate functions, no difference exists between using %SelectInit or %Select.

%Space

Description

Use the %Space meta-variable to specify a single space. Usage is similar to %Comma.

See Also

[Chapter 5, "Using Meta-SQL and PeopleCode," %Comma, page 79](#)

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %SQL

%SQL

Description

Use the %SQL construct to specify a SQL object, which replaces the %SQL construct in a statement. This construct enables commonly used SQL text to be shared among Application Engine and PeopleCode programs. In Application Engine, you use %Bind to specify bind variables. In PeopleCode SQL, you can use

```
:record.field
```

or

```
:1
```

If you create SQL objects that you plan to share between Application Engine and PeopleCode programs, the %SQL construct enables you to pass parameters for resolving bind variables without being concerned with the difference in the bind syntax that exists between Application Engine and PeopleCode. However, you must tailor the base SQL statement that uses %SQL to represent a shared object with binds to Application Engine or to PeopleCode.

When a SQL object specified has more than one version, the database type always takes precedence. That is:

- If one or more versions of a SQL definition are found for the database type of the current database connection and if any of the versions have an effective date less than or equal to the current date, then the most recent version is used.

- If no versions are found for the current database type or if all of the versions have effective dates greater than the current date, then the system looks for an effective version of the SQL definition under the database type Generic. If no version is found, an error occurs.

Example

For example, assume that your SQL is similar to the following:

```
UPDATE PS_TEMP_TBL SET ACTIVE = %BIND(MY_AET.ACTIVE)
WHERE PROCESS_INSTANCE = %ProcessInstance
```

This code would not be valid if the SQL ran in PeopleCode. However, if you define your SQL as shown, you could use parameters in %SQL to insert the appropriate bind variable:

```
UPDATE PS_TEMP_TBL SET ACTIVE = %P(1)
WHERE PROCESS_INSTANCE = %ProcessInstance
```

From Application Engine, the base SQL, or source statement, might look like this:

```
%SQL(SQL_ID, %BIND(MY_AET.ACTIVE))
```

The PeopleCode SQL might look like this:

```
%SQL(SQL_ID, :MY_AET.ACTIVE)
```

Note. You can use %SQL only to reference SQL objects created directly in Application Designer. For instance, you cannot use %SQL to reference SQL that resides within a section in an application library. Common SQL should be stored as a proper SQL object.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %SQL

%SQLRows

Description

Use the %SQLRows meta-variable to specify whether a SQL action returned any rows.

You can use %SQLRows in any Application Engine SQL statement, but the underlying value is affected only by SQL actions. It is not affected by Do When, Do Select, Do While, and Do Until actions. For Select statements, the value can only be 0 or 1: row not found or rows found, respectively. It does not reflect the actual number of rows that meet the Where criteria. To find the number of rows that meet the Where criteria, code a Select Count (*) statement.

%Substring

Description

Because the %Substring function can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %Substring

%Table

Syntax

```
%Table(recname)
```

Description

Use the %Table construct to return the SQL table name for the record specified with *recname*.

This construct can be used to specify temporary tables for running parallel Application Engine processes across different subsets of data.

Example

For example, the following statement returns the record PS_ABSENCE_HIST:

```
%Table(ABSENCE_HIST)
```

If the record is a temporary table and the current process has a temporary table instance number specified, then %Table resolves to that instance of the temporary table PS_ABSENCE_HIST nn , where nn is the instance number.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %Table

%Test

Description

Because the %Test construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %Test

%TextIn

Description

Because the %TextIn construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %TextIn

%TimeAdd

Description

Because the %TimeAdd construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %TimeAdd

%TimeIn

Description

Because the %TimeIn construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %TimeIn

%TimeNull**Description**

Because the %TimeNull meta-variable can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %TimeNull

%TimeOut**Description**

Because the %TimeOut construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %TimeOut

%TimePart**Description**

Because the %TimePart function can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %TimePart

%TrimSubstr

Description

Because the %TrimSubstr function can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %TrimSubstr

%Truncate

Description

Because the %Truncate function can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %Truncate

%TruncateTable

Syntax

```
%TruncateTable( table name )
```

Description

Use the %TruncateTable construct to invoke a bulk delete command on a table. This construct is functionally identical to a Delete SQL statement with no Where clause, but it is faster on databases that support bulk deletes. If you are familiar with COBOL, this construct is an enhanced version of the COBOL meta-SQL construct with the same name.

Some database vendors have implemented bulk delete commands that decrease the time required to delete all the rows in a table by not logging rollback data in the transaction log. For the databases that support these commands, Application Engine replaces %TruncateTable with Truncate Table SQL. For the other database types, %TruncateTable is replaced with Delete From SQL.

You should commit after the step that immediately precedes the step containing the %TruncateTable statement. In general, you should use this construct early in your Application Engine program as an initialization task. In addition, avoid using this meta-SQL when your Application Engine program is started from the PeopleCode CallAppEngine function.

Unlike the COBOL version, Application Engine determines if a commit is possible before making the substitution. If a commit is possible, Application Engine makes the substitution and then forces a checkpoint and commit after the delete runs successfully.

If a commit is not possible, Application Engine replaces the meta-SQL with a Delete From string. This string ensures restart integrity when your program runs against a database for which an implicit commit is associated with Truncate Table or for which rollback data is not logged.

For databases that either run an implicit commit for %TruncateTable or require a commit before or after this meta-SQL, replace %TruncateTable with an unconditional delete in the following circumstances:

- A commit is not allowed, as in an Application Engine program called from PeopleCode.
- The program issues a non-select SQL statement since the last commit occurred. In such a situation, data is likely to have changed.
- You are deferring commits in a Select/Fetch loop within a restartable program.

Note. To use a record name as the argument for %TruncateTable (instead of an explicit table name), you must include a %Table meta-SQL function to resolve the unspecified table name. For example, to specify the record PO_WEEK as the argument, use the following statement:

```
%TruncateTable(%Table(PO_WEEK)).
```

See Also

[Chapter 5, "Using Meta-SQL and PeopleCode," %Table, page 109](#)

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %TruncateTable

%Update

Description

Because the %Update shortcut can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

Note. This meta-SQL can only be used in PeopleCode programs, not in Application Engine SQL actions.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %Update

%UpdatePairs

Description

Because the %UpdatePairs construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

Note. This meta-SQL can only be used in PeopleCode programs, not in Application Engine SQL actions.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %UpdatePairs

%UpdateStats

Syntax

```
%UpdateStats(record name , [HIGH/LOW])
```

For example,

```
%UpdateStats ( PO_WRK1 )
```

The default is LOW.

Description

Use the %UpdateStats construct to generate a platform-dependent SQL statement that updates the system catalog tables used by the database optimizer in choosing optimal query plans. Use this construct after your program has inserted large amounts of data into a temporary table that will be deleted before the end of the program run. This construct saves you from having to use dummy seed data for the temporary table and having to update statistics manually.

Notes About %UpdateStats

For databases that either run an implicit commit for %UpdateStats or require a commit before or after this meta-SQL, Application Engine skips %UpdateStats in the following circumstances:

- A commit is not allowed, as in an Application Engine program called from PeopleCode.
- The program issues a non-select SQL statement since the last commit occurred.

In such a situation, data is likely to have changed.

- You are deferring commits in a Select/Fetch loop in a restartable program.

Application Engine skips %UpdateStats even if the previous condition is false.

The following table shows how the %UpdateStats construct is resolved by the supported database systems:

Database Function	Behavior
MSS %UpdateStats	Specifying LOW produces the statement <pre>UPDATE STATISTICS tablename</pre> Specifying HIGH produces the statement <pre>UPDATE STATISTICS tablename WITH FULLSCAN</pre>
Sybase %UpdateStats	LOW and HIGH = UPDATE ALL STATISTICS <i>tablename</i>
Oracle %UpdateStats	Oracle uses DDL templates (in PSDDLMODEL) to determine SQL statements for %UpdateStats. Use DDLORA.DMS to change. Specifying LOW produces the statement <pre>execute DBMS_STATS.GATHER_TABLE_STATS (ownname=> 'PT8468908', tabname=>'PSSTATUS', estimate_percent=> >20, method_opt=> 'FOR ALL INDEXED COLUMNS SIZE=> 1',cascade=>TRUE)</pre> Specifying HIGH produces the statement <pre>execute DBMS_STATS.GATHER_TABLE_STATS (ownname=> 'PT848908', tabname=>'PSSTATUS', estimate_percent=> dbms_stats.auto_sample_size, method_opt=> 'FOR ALL-> INDEXED COLUMNS SIZE 1',cascade=>TRUE)</pre>
DB2 UNIX %UpdateStats	In DB2 UNIX, %UpdateStats is performed by issuing sqlustat() calls that are equivalent to SQL statements. The sqlustat() is an internal DB2 API call function rather than an SQL command. Specifying LOW is equivalent to issuing the statement <pre>RUNSTATS ON TABLE tablename AND INDEXES ALL</pre> Specifying HIGH is equivalent to issuing the statement <pre>RUNSTATS ON TABLE tablename WITH DISTRIBUTION AND-> DETAILED INDEXES ALL</pre> <p>Note. You cannot view the sqlustat() calls nor the RUNSTATS statement in the SQL trace.</p>

Database Function	Behavior
DB2 390 %UpdateStats	<p>Uses a DDL model template (in PSDDLMODEL) to format a control statement for the DB2 UDB for OS390 and z/OS Runstats utility. Refer to the PeopleTools Installation Guide and the Administration Guide for more details on using %UpdateStats with DB2 UDB for OS390 and z/OS.</p> <p>Specifying LOW produces the statement</p> <pre>RUNSTATS TABLESPACE [DBNAME].[TBSPCNAME] TABLE([=> DBNAME].[TABLE]) SAMPLE 25 [INDEXLIST] REPORT NO=> SHRLEVEL CHANGE UPDATE ACCESSPATH</pre> <p>Specifying HIGH produces the statement</p> <pre>RUNSTATS TABLESPACE [DBNAME].[TBSPCNAME] TABLE([=> DBNAME].[TABLE]) [INDEXLIST] REPORT NO SHRLEVEL=> CHANGE UPDATE ACCESSPATH</pre>
Informix %UpdateStats	<p>Specifying LOW produces the statement</p> <pre>UPDATE STATISTICS MEDIUM FOR TABLE tablename</pre> <p>Specifying HIGH produces the statement</p> <pre>UPDATE STATISTICS HIGH FOR TABLE tablename</pre>

%UpdateStats Database Considerations

The following table lists potential issues that you might encounter when using %UpdateStats:

Database	Consideration
Microsoft SQL Server Sybase UDB	<p>Application Engine forces a commit before and after the %UpdateStats statement.</p> <p>Therefore, the system skips this meta-SQL if a commit is not allowed. For instance, a commit is not allowed in the following situations:</p> <ul style="list-style-type: none"> • The Application Engine program is not running in batch mode. • You have issued non-Select/Fetch SQL (in which the data is likely to change) since the last commit. • You are deferring commits in a Select/Fetch loop within a restartable program.
Oracle	<p>Oracle has an implicit commit after the %UpdateStats statement executes. Same behavior as previous consideration.</p>

Database	Consideration
DB2 UDB for OS/390 and z/OS	<p>For DB2 UDB for OS/390 and z/OS, %UpdateStats requires IBM stored procedure DSNUTILS running in an authorized Work Load Manager Application Environment. It is also highly recommended that individual tables intended to be a target of the %UpdateStats function are segregated to their own tablespaces. Refer to the following documents for more details on using %UpdateStats: PeopleTools Installation Guide for DB2 UDB for OS/390 and z/OS; PeopleTools Administration Guide for DB2 UDB for OS/390 and z/OS.</p> <p>Note. You can trace information messages from the Runstats command on DB2 for z/os executed as a result of issuing %UpdateStats. To enable this trace, select the SQL Informational Trace check box on the Configuration Manager – Trace page.</p>
Informix IBM UDB	<p>%UpdateStats locks the table being analyzed on UDB and Informix. Therefore, use this meta-SQL only on tables that are not likely to be concurrently accessed by other applications and users. You might use %UpdateStats to analyze Application Engine dedicated temporary tables.</p>
All	<p>%UpdateStats consumes a large amount of time and database resources if run against very large tables. Therefore, analyze permanent data tables outside of application programs. Also, if temporary tables are likely to grow very large during a batch run, run the batch program only with %UpdateStats enabled to seed the statistics data or when the data composition changes dramatically.</p>

Disabling %UpdateStats

You can disable %UpdateStats in the following ways:

- Include the following parameter on the command line when running an Application Engine program:
 -DBFLAGS 1
- Change the Dbflags=0 parameter in the PeopleSoft Process Scheduler configuration file (or PSADMIN) to Dbflags=1.

Using %UpdateStats With COBOL

You can use the %UpdateStats construct from SQL embedded in COBOL programs. Use this syntax:

```
%UpdateStats(tablename)
```

When you issue this construct from PeopleTools, the parameter is *record name*.

%Upper

Description

Because the %Upper construct can be used in more than just Application Engine programs, it is documented in the *PeopleTools 8.52: PeopleCode Language Reference PeopleBook*.

See Also

PeopleTools 8.52: PeopleCode Language Reference, "Meta-SQL Elements," %Upper

Chapter 6

Managing Application Engine Programs

This chapter discusses how to:

- Run Application Engine programs.
- Debug Application Engine programs.
- Restart Application Engine programs.
- Cache the Application Engine server.
- Free locked temporary tables.

Running Application Engine Programs

This section provides an overview of program run options and discusses how to:

- Create process definitions.
- List process definition parameters.
- Start programs with the Application Engine Process Request page.
- Use PeopleCode to invoke Application Engine programs.
- Use the command line to invoke Application Engine programs.

Understanding Program Run Options

You run Application Engine programs in one of the following modes: batch using PeopleSoft Process Scheduler, online using a PeopleCode function, or manually using the command line. The following table lists some differences between online and batch programs:

Online Execution	Batch Execution
Started by the CallAppEngine function from PeopleCode.	Started through PeopleSoft Process Scheduler.
Program runs quickly, synchronously, and at random times.	Programs run for longer amounts of time, asynchronously, and at scheduled times.

Online Execution	Batch Execution
Potential for simultaneous runs.	Can be designed for parallel runs for performance.
Uses the online temporary table pool.	Uses the batch/dedicated temporary table pool.

Batch Programs Using PeopleSoft Process Scheduler

The most typical run mode is batch. You invoke programs that run in this mode using PeopleSoft Process Scheduler or the Application Engine Process Request page. Batch mode is also referred to as an asynchronous run, meaning that it runs independently in the background. Application Engine runs on any operating system that Oracle supports as an application server. If your site uses an operating system that is not supported for Application Engine, you must run Application Engine programs on the application server. The only exception is OS/390 (z/OS).

To run Application Engine programs on the batch server, you must install BEA Tuxedo. This condition applies to both UNIX and Microsoft Windows NT batch servers. If you run your batch server on the same server machine as your application server, then the application server and the batch server can share one BEA Tuxedo installation. If your batch server is separate from your application server, then you must install BEA Tuxedo on your batch server.

The TOOLBINSRV parameter in the PeopleSoft Process Scheduler configuration file determines where PeopleSoft Process Scheduler invokes an Application Engine program. For high-volume batch environments, specify the PS_HOME\bin\server\winx86 directory that exists on the same machine where the Application Engine program runs.

Online Programs Using PeopleCode

Application Engine programs that run online are typically run from a page with the CallAppEngine PeopleCode function. Such online processes are synchronous, meaning that subsequent processes wait for the results. For instance, a page may be frozen until the online process returns the necessary results. With the CallAppEngine function, no Commit statements are issued. However, if you use the asynchronous online PeopleCode option, ProcessRequest, Commit statements are allowed.

Manual Programs Using the Command Line

Usually, you use this mod only during testing or if you need to restart a program manually.

Creating Process Definitions

Select PeopleTools, Process Scheduler, Processes to access the Processes - Process Definition page.

Process Definition | Process Definition Options | Override Options | Destination

Process Type: Application Engine
 Name: AEMINTEST

*Description: Simple AE test program API Aware
 Long Description: Simple AE program to test that AE works. Restart Enabled?
 Retry Count: 0

*Priority: Medium Retention Days: 0
 *Process Category: Default Default Category

System Constraints
 Max Concurrent: Max Processing Time: minutes

Mutually Exclusive Process(es) Customize | Find | First 1 of 1 Last

	*Process Type	*Process Name	Description
1	<input type="text"/>	<input type="text"/>	

Processes - Process Definition page

To use PeopleSoft Process Scheduler for starting Application Engine batch programs, create a process definition for each program. Running Application Engine programs is similar to running any COBOL or Structured Query Report (SQR) program that you typically invoke with PeopleSoft Process Scheduler. Use Application Engine as the generic process type definition. Each Application Engine program that you invoke using PeopleSoft Process Scheduler requires a unique process definition derived from the generic process type definition.

Note. When creating a process definition based on the Application Engine process type definition, the process name you assign must match your Application Engine program name exactly.

Listing Process Definition Parameters

Select PeopleTools, Process Scheduler, Processes, Process Definition Options to access the Processes - Process Definition Options page.

The screenshot displays the 'Process Definition Options' page. At the top, there are navigation tabs: 'Process Definition', 'Process Definition Options' (which is active), 'Override Options', 'Destination', and 'Page Transfer'. Below the tabs, the following information is visible:

- Process Type:** Application Engine
- Name:** AEMINTEST
- Server Name:** [Empty text box with a search icon]
- Recurrence Name:** [Empty text box with a search icon]

There are three main sections below:

- On File Creation:** Includes a 'File Dependency' checkbox (unchecked), a 'Wait for File:' text box, and a 'Time Out Max Minutes:' text box.
- System Recovery Process:** Includes a 'Process Type:' text box and a 'Process Name:' text box, both with search icons.
- Process Security:** Contains two sub-sections:
 - Component:** A list with two entries: 'AE_REQUEST' and 'PRCSMULTI'. Each entry has a search icon, a '+' button, and a '-' button.
 - Process Groups:** A list with one entry: 'TLSALL'. It has a search icon, a '+' button, and a '-' button.

Processes - Process Definition Options page

Use this page to list parameters. The complete parameter list is:

- -ct MICROSOFT
- -cd %%DBNAME%%
- -co %%OPRID%%
- -cp %%OPRPSWD%%
- -r %%RUNCNTLID%%
- -i %%INSTANCE%%
- -ai %%PRCSNAME%

Starting Programs with the Application Engine Process Request Page

You also can start an Application Engine program by using the Application Engine Process Request page. Using this request page enables you to specify values and parameters in addition to those that appear within PeopleSoft Process Scheduler process definitions.

Most users start Application Engine programs from an application-specific request page using PeopleSoft Process Scheduler. A systems expert or power user may, at times, need to create custom process requests that require multiple programs to perform parallel processing or that need to set specific, initial values in a state record. You might use the Application Engine process request page for one of these cases.

Note. Generally, if seed data or other Application Engine request settings are required for a particular program, the application-specific request page has SQL executables that do the work that is transparent to the user. Typically, no user should invoke programs from the generic process request page. Use this page for internal testing and as a basis for designing program-specific request pages.

Tables Used in the Process Request Page

The Application Engine process request page inserts values into the following tables:

- **AEREQUESTTBL**
Contains all of the values that appear on the page except those in the Parameters group box.
- **AEREQUESTPARAM**
Includes only initial state record values specified in the Parameters group box, if needed.

Note. Inserting a row in either of the Application Engine request tables is not required to run an Application Engine program. This change is a key difference between Application Engine versions prior to PeopleTools 8, where a row in Application Engine request tables is required to start a program, regardless of how it is invoked. The run control ID is available to your program using %RunControl, whether or not a row is inserted into the AEREQUESTTBL table.

You need to use the Application Engine Request page to invoke Application Engine and insert a row into the Application Engine request records only if you need to perform any of the following tasks:

- Insert initial values into the state records associated with a particular program.
- Set an as-of date for the Application Engine program to perform retroactive processing.
- Set a non-default market for the program.
- Set up a temporary table image to use if you are submitting a PeopleSoft EPM process request that performs parallel processing. Refer to PeopleSoft EPM application documentation for details.

Note. Entries in the AEREQUESTTBL table do not have any effect on Application Engine programs called from PeopleCode using the CallAppEngine function.

Application Engine Requests

Select PeopleTools, Application Engine, Request AE to access the Application Engine Request page.

Note. The RemoteCall function is no longer valid for invoking Application Engine programs in PeopleCode. However, the RemoteCall function still applies to calling other COBOL functions. If you do not convert the RemoteCall PeopleCode that previously called an Application Engine program to use the new function, an error message appears.

Use CallAppEngine if the program you are invoking is a quick process. Because the process is synchronous, users must wait for any process invoked by CallAppEngine to complete before starting another process. If the called program causes an unreasonable delay, then use another alternative, such as the ScheduleProcess PeopleCode function.

Use CallAppEngine when you have a complex, SQL-intensive business process that must run in batch and online, or the process requires the use of dedicated temporary tables. If this is not the case, you are usually better off writing the entire program in native PeopleCode. If you have written logic in PeopleCode, presumably for online execution, and you want to reuse it in a batch program, you may be forced into row-by-row processing. Design the batch logic first and then decide whether to have a separate online version or reuse the batch code using CallAppEngine. Consider the trade-off between code reuse and performance. It is inherently more difficult, but not impossible, to develop a common solution that performs adequately in both batch and online environments.

Do not use CallAppEngine within an Application Engine PeopleCode step. If you need to call an Application Engine program from another Application Engine program, you must use the Call Section action.

Do not use CallAppEngine to control the commit operation. Programs called with CallAppEngine are embedded within a larger unit of work defined by the page trigger, such as a page save.

Note. Online PeopleCode that calls CallAppEngine should be set to run on the application server. You encounter performance issues if you run PeopleCode on the client in a three-tier configuration because every SQL statement that Application Engine issues must be serialized and then sent to the application server to be run.

Using the Command Line to Invoke Application Engine Programs

You might invoke an Application Engine program through the command line to:

- Restart

When a program abends, a system administrator might restart the program using the command line. If needed, you can locate all of the specific program and process information from Process Monitor in the Process Request Detail dialog box. Normally, users or system administrators perform a restart from the Process Monitor.

- Develop or test

Many developers include the command line in a batch file to launch a program they are developing or testing. This way, they can quickly execute the batch file as needed. This method also enables separation of development of the application program from its associated pages.

- Debug

To debug a program running on the server, you can sign into the server (using telnet, for example) and invoke the program from the command line.

To start an Application Engine program from the command line, you must specify the Application Engine executable (PSAE.EXE) followed by the required parameters, as shown in this example:

```
psae -CT dbtype -CS server -CD database_name -CO oprid -CP oprpswd?
-R run_control_id -AI program_id -I process_instance -DEBUG (Y|N)?
-DR (Y|N) -TRACE tracevalue -DBFLAGS flagsvalue -TOOLSTRACESQL value?
-TOOLSTRACEPC value -OT outtype -OF outformat -FP filepath
```

Or, if your command line options are stored in a text file, you can enter:

```
psae optfilename
```

Note. For Microsoft Windows NT and UNIX servers, you must set the PS_SERVER_CFG environment variable before you invoke an Application Engine program from the command line. PS_SERVER_CFG must contain the fully qualified name of a correctly configured Process Scheduler PSPRCS.CFG file. When Application Engine runs from the command line, it resolves %PS_SERVDIR% to the value of the environment variable PS_SERVDIR instead of the parent directory of a Process Scheduler configuration.

Command Line Options

- CT** Specify the type of database to which you are connecting. Values are *ORACLE*, *MICROSFT*, *SYBASE*, *INFORMIX*, *DB2UNIX*, and *DB2ODBC*.
- CS** Required for Sybase and Informix. For platforms that require a server name as part of their signon, enter the appropriate server name. This option affects Sybase, Informix, and Microsoft SQL Server. However, for Microsoft SQL Server, this option is valid but not required.
- CD** Enter the name of the database to which the program will connect.
- CO** Enter the user ID of the person who is running the program.
- CP** Enter the password associated with the specified user ID.
- R** Enter the run control ID to use for this run of the program.
- AI** Specify the Application Engine program to run.
- I** Required for restart, enter the process instance for the program run. The default is *0*, which means Application Engine uses the next available process instance.
- DEBUG** This parameter controls the Debug utility. Enter *Y* to indicate that you want the program to run in debugging mode or enter *N* to indicate that you do not.
- DR** This parameter controls restart disabling. Enter *Y* to disable restart or enter *N* to enable restart.

-TRACE

To enable tracing from the command line, enter this parameter and a specific trace value. The value you enter is the sum of the specific traces that you want to enable. Traces and values are:

1: Initiates the Application Engine step trace.

2: Initiates the Application Engine SQL trace.

128:: Initiates the Application Engine timings file trace, which is similar to the COBOL timings trace.

256: Includes the PeopleCode detail timings in the 128 trace.

1024: Initiates the Application Engine timings table trace, which stores the results in database tables.

2048: Initiates the database optimizer explain, writing the results to the trace file. This option is supported only on Oracle, Informix, and Microsoft SQL Server.

4096: Initiates the database optimizer explain, storing the results in the Explain Plan table of the current database. This option is supported only on Oracle, DB2, and Microsoft SQL Server.

For example, to enable the 1, 2, and 128 traces, you would enter *131*, the sum of 1, 2, and 128. To indicate that you do not want any traces, enter *0*. If you do not explicitly enter *0*, Application Engine uses the trace value set in PeopleSoft Configuration Manager.

8192: Sets a trace for PeopleSoft Integration Broker transform programs.

16384: Initiates the statement timings trace but stores the results in the PS_AE_TIMINGS_LG and PS_AE_TIMINGS_DT tables.

-DBFLAGS

To disable %UpdateStats meta-SQL construct, enter *1*.

-TOOLSTRACESQL

Enable a SQL trace.

-TOOLSTRACEPC

Enable a PeopleCode trace.

-OT

(Optional) Initialize the PeopleCode meta-variable %OutDestType (numeric).

PeopleCode example of %OutDestType:

```
&ProcessRqst.OutDestType = %OutDestType ;
```

-OF

(Optional) Initialize the PeopleCode meta-variable %OutDestFormat (numeric).

PeopleCode example of %OutDestFormat:

```
Query.RunToFile(Record QryPromptRecord, %OutDestFormat);
```

-FP

(Optional) Initialize the PeopleCode meta-variable %FilePath (string).

PeopleCode example of %FilePath:

```
If All(%FilePath) Then
    &FILENAME = %FilePath | &FILENAME;
&MYFILE = GetFile(&FILENAME, "E", %FilePath_Absolute);
Else
    &MYFILE = GetFile(&FILENAME, "E", %FilePath_Relative);
End-If;
```

optfilename

If you submit a file to Application Engine as the first parameter in the command line, Application Engine reads the contents of the file and interprets the contents as if it were parameters entered on the command line. This option is intended mainly for the Microsoft Windows NT or UNIX Process Scheduler server environment. For example, you might enter *psae \$temp/myparamfile.txt*.

Note. For security reasons, after Application Engine interprets the contents of the parameter file, it immediately deletes the file.

Debugging Application Engine Programs

This section discusses how to:

- Enable the Application Engine debugger.
- Set debugging options.

Enabling the Application Engine Debugger

To run a program in debug mode:

1. Set the debug option.

You can set the debug option in the following locations:

- Start PeopleSoft Configuration Manager and select the Process Scheduler tab.

In the Application Engine group, enable debug by selecting the Debug check box. This method applies to all methods of invocation.

- If you used the command line option to invoke your Application Engine program, then you can include the `-DEBUG Y` parameter in the command line you submit to `PSAE.EXE`.

If the Debug check box is already selected in PeopleSoft Configuration Manager, then you do not need to include the `-DEBUG` parameter in your command line.

Note. Setting debug capabilities in either PeopleSoft Configuration Manager or the command line turns debug mode on. However, if you have debug enabled in Configuration Manager and you submit `-DEBUG N` on the command line, then the PeopleSoft Configuration Manager setting defines your default command line value and the command line can override the default.

- If you have PeopleCode in your Application Engine program, enable the PeopleCode debugger.

When you launch your program and the PeopleCode action runs, enter the PeopleCode debugger.

2. Run the Application Engine program to debug.
3. At the Application Engine Debugger prompt, enter a command to enable a debugging option.

Each command is represented by a single letter, such as *X*, *L*, or *M*. Enter the letter that corresponds to the option you want to engage. To see a list of the available debugging options, enter `?` at the prompt.

To enable the PeopleCode debugger for Application Engine:

1. Sign on to PeopleTools using the same user ID that you will use to invoke the Application Engine program.
2. Open Application Designer.
3. Select Debug, PeopleCode Debugger Mode.

Your Application Engine program can be open on the desktop, but you do not need to open the Application Engine program or the PeopleCode action that you want to debug.

4. Select Debug, Break at Start.

This command will cause the Application Engine program to break before executing any PeopleCode programs within it.

Setting Debugging Options

Each debugger option is represented by a single letter that you specify at the prompt. To engage the option you select, press Enter.

Debugging Tips

Become familiar with these tips about debugging programs:

- In some cases, such as when setting breakpoints or watch fields, submenus offer additional options.

After you are familiar with the commands, you can enter multiple items on the command line to combine commands and bypass the submenus. For example, to see a list of the breakpoints, you could enter `B L`.

To set a field as a watch field, you could enter `W S MY_FIELD`.

To set a field as a watch field on a different state record, enter `W S MY_AET.MY_FIELD`.

Note. The exception to this option is `Modify`, which always displays the current value and then prompts you to enter a new value. You can, however, enter `M MY_AET.MY_FIELD` to go directly to the new value prompt.

- Letter commands are not case-sensitive.

For example, `Q` and `q` are valid commands.

Debugging Options

<i>Option</i>	<i>Description</i>
Quit	<p>Enter <code>Q</code>. This option performs a rollback on the current unit of work in the debugging run, and it ends the debugging session. It effectively terminates your Application Engine program.</p> <p>Quit is useful for testing restart. Have some work committed and some uncommitted. Then, terminate the program at that point and roll back the pending work. You want to make sure the program restarts from the point of the last successful commit.</p>
Exit	<p>This option is valid only after one step has completed and another has not already begun. It is not valid once you reach the action level.</p> <p>Use this option as an alternative to <code>Quit</code>. <code>Exit</code> ends the program run and the debugging session, but it also commits the current unit of that the program has already completed. This option can be helpful when testing your restart logic.</p>
Commit	<p>Enter <code>C</code> to commit the current unit of work in your program. This option is valid only after a step has completed and before another begins. It is not valid after you reach the action level.</p> <p>You can use this option, for example, to use your database query tool to check the data in your database.</p>

Option	Description
Break	<p>Enter B to set a breakpoint. When the program reaches the breakpoint, it temporarily halts execution to enable you to observe the state of the current process.</p> <p>Breakpoint options include:</p> <p>Set: Enter S to set a breakpoint location.</p> <p>The breakpoint location appears by default at the current location in the program, but you can specify other sections or steps by overriding the default values that appear in brackets.</p> <p>Unset: Enter U to remove breakpoints previously set.</p> <p>List: Enter L to list breakpoints. When you enter this command, make sure that you have entered B first to specify the break option. If you enter L from the main command prompt, you engage the Look option.</p>
Look	<p>Enter L to observe the values currently in the state record associated with the program you are debugging. You must specify the state record at the Record Name prompt. By default, the default state record as specified in your program properties appears in brackets.</p> <p>You can also specify a specific field name on the state record in the Field Name prompt. To look at all the fields in the state record, leave the asterisk (*) within the brackets unchanged.</p>
Modify	<p>Enter M to modify the value of a state record value for debugging purposes. Suppose the previous steps did not set a value correctly but you want to see how the rest of the program would perform if the appropriate value existed in the state record. This option enables you to help your program in the debugging or testing phase.</p> <p>As with the Look command, you must specify the appropriate state record (if you are using multiple state records), and you must specify one field. You can modify only one field at time.</p>
Watch	<p>Enter W to specify a field as a watch field. The program stops when the field value changes.</p> <p>Similar to the Break command, you can specify options for Set, Unset, and List.</p>
Step Over	<p>Enter S to run the current step to completion and stop at the next step in the current section.</p> <p>The behavior depends on the current level or the program. You start at the step level, and then can step into the action level. If you are at the step level and use step over, you go to the next step in the current section, skipping over all actions (including any call sections). If you are at the action level, step over executes the current action and stops at the next action in the current step, or at the next step in the current section.</p>

Option	Description
Step Into	<p>Enter I to observe a step or called section in more detail. For instance, you can check each SQL statement and stop. By using this option and checking the state record at each stop, you can easily isolate problem SQL or PeopleCode.</p> <p>As with Step Over, the behavior depends on the level. At the step level, you can step into the action level and stop before the first action in the step. At the action level, if the current action is a call section, this option takes you to the first step in the called section. For other action types, this option acts the same as the Step Over option because no deeper level exists in which to step.</p>
Step Out of	<p>Liz Enter O. After you've stepped into a step or called section, use the Step Out of option to run the rest of the current step or called section and stop. As with the previous step options, the behavior of Step Out of depends on the current level of the program.</p> <p>At the step level, Step Out of completes the remaining steps in the current section, returns to the calling section or step, and stops at the next action in that step. If the section is MAIN and is not called by another section or step, then Step Out of behaves the same as the Go option.</p> <p>At the action level, Step Out of completes the current step and stops at the next step in the current section, or if the program is at the end of a section, Step Out of returns to the calling section or step.</p>
Go	<p>Enter G. After the program has stopped at a specific location, and you've examined its current state, you can use the Go command to resume the execution of the program. This is a helpful command when you have breakpoints set. With this command, the program won't stop at a step or action; it only stops at the next breakpoint or watch field, or when the program runs to completion.</p>
Run to commit	<p>Enter R. Resumes execution of your program after it has stopped. This command forces the program to stop again after the next commit. This is a good option to use when observing your commit strategy and how it will affect a restart.</p>

Example of the Look Option

To view the value stored in a specific field of the state record after a step or action, enter the appropriate field name at the Field Name prompt. For example, if you entered AE_TESTAPPL_AET at the Record Name prompt and AE_INT_6 at the Field Name prompt, you would see the value of the AE_INT_6 field in the AE_TESTAPPL_AET record.

You can also use an asterisk (*) as a wildcard to get a partial list. For example, if you enter AE_INT* at the Field Name prompt, you see only the fields that start with AE_INT; this is also true for the Record Name prompt. This feature is useful for both listing multiple fields across multiple records and as a shortcut. If you know that only one state record starts with XXX, you do not have to type the full name, just type XXX.

Example of the Modify Option

If you wanted to set the AE_INT_15 field in the AETESTPROG to 10, you would enter the record (AE_TESTAPPL_AET) at the Record Name prompt and the field (AE_INT_15) at the Field Name prompt.

Then you would see the current value of the field. At the prompt, you could enter a new value.

Using the Look command, you can check to see that the value you specified now exists in the state record.

Example of the Watch Option

Enter *S* to set a watch field. After you enter *S*, you enter the record name (such as AE_TESTAPPL_AET) and field name (such as AE_INT_7) at the appropriate prompts.

Enter *U* to unset, or remove, a watch field from the list. After you enter *U*, you see a list of active watch fields. Enter the watch field ID number to remove a field. For example, if the field AE_INT_7 were second in the watch field list, you would enter 2 to remove it.

After a step or action completes, enter *L* to list, or view, the values of all the fields that you included in the watch list.

Note. You cannot set a watch on a long text field.

Restarting Application Engine Programs

A key feature of Application Engine is its built-in checkpoint and restart capabilities. If a program step terminates abnormally or fails, you can restart the request from the last successful checkpoint or from the step immediately preceding the step that failed. You restart the program from the process request page.

This section provides an overview of restart and discusses how to:

- Determine when to use restart.
- Control abnormal terminations.
- Restart Application Engine programs.
- Start Application Engine programs from the beginning.
- Enable and disable restart.

Understanding Restart

Application Engine programs save to the database (perform a commit) only when an entire program successfully completes. You must set individual commits where appropriate.

At the section level, you can set a commit after each step in a section. At the step level, you can require or defer commits for individual steps, or you can increase the commit frequency within a step to *N* iterations of a looping action, such as a Do Select or Do While, within a step.

The commit level that you select affects how restart works in a program. Each time Application Engine issues a commit with restart enabled, it records the current state of the program. The recording of the current state that Application Engine performs is referred to as a checkpoint.

Using the restart feature enables you to perform commits more often in a program. Restart reduces the overall effect on other users and processes while the background program is running because it reduces the number of rows that are locked by the program. Fewer rows allows multiple instances of the program to run concurrently (parallel processing), which may be useful for high-volume solutions.

With restart, if a failure occurs at any point in the process, the user can restart the program and expect the program to behave as follows:

- Ignore the steps that have already completed up to the last successful commit.
- Begin processing at the next step after the last successful commit.

The ability for Application Engine to remember completed steps depends on a record called `AERUNCONTROL`, which is keyed by process instance.

When a program runs, each time Application Engine issues a commit it also saves all of the information required for a program restart in the `AERUNCONTROL` record.

Determining When to Use Restart

Usually, you want to develop programs to take advantage of Application Engine restart capabilities. Programs that are good candidates for restart do a lot of preparation work initially, such as joining tables and loading data into temporary work tables. Also, you should consider restart capabilities for programs that might put data in an unstable state if they terminate abnormally during a run. As a general rule, restart is essential for programs that primarily do set-based processing.

However, you may want to disable restart if your program has one the following characteristics:

- It is mainly row-by-row processing.
- The overhead involved with Application Engine performing a checkpoint during the program run is not desirable.
- The program commits after N iterations of a looping construct within a step, and the `Select` statement driving the loop is composed in such a way that if the program terminated and then started again it would ignore transactions that were already processed in the previous program run. In a sense, the program processes the restart internally: Application Engine treats each start of a program as a fresh start, instead of restarting a previous instance.

When developing for restart, consider the consequences if a program fails and you cannot restart the program. Given the commit structure that you defined for your Application Engine program, would your data remain in an usual state if a failure were to occur after any of the commits? Would it be easy to recover from such a case?

Using Restart at the Program Level

Application Engine automatically updates all state records. When an Application Engine program starts, it inserts a row in the state record for the assigned process instance. Then the system updates the state record whenever the program performs a commit to store changed values into the database. Finally, the system deletes the state record row upon successful completion of the application.

However, if the state record the program uses is a work record, you cannot make any database updates to the record. Consequently, if you restart the program, you might get unexpected results because the memory was lost when the program terminated. In fact, the system re-initializes any state records that are work records at each commit in order to ensure consistent behavior during a normal run and a restarted run. Therefore, you may need to make at least one of your state records a SQL table to contain values that must be retained across commits or in case of termination.

Finally, the other consideration for programming for restart at the program level is to check both the Application Engine Program Properties dialog box and PeopleSoft Configuration Manager to make sure the Disable Restart check box is not selected.

Using Restart at the Section Level

The section level property associated with restart is section type, which has the options Prepare Only and Critical Updates.

If a section only prepares data, as in selecting it, populating temporary tables, or updating temporary tables, then set the section type to Prepare Only. However, if the section updates permanent application tables in the database, then set the option to Critical Updates.

During runtime, when the system arrives at the first section set to Critical Updates, it sets the AE_CRITICAL_PHASE value in the AERUNCONTROL record to *Y*. Once set, the value of AE_CRITICAL_PHASE remains *Y* until the program completes successfully. When the program completes, the corresponding row in AERUNCONTROL is deleted. Therefore, a Prepare Only section following the Critical Updates section will not reset the AE_CRITICAL_PHASE value to *N*.

If your program terminates, the user can check the AE_CRITICAL_PHASE value. If it is *Y*, then the user knows that the section that failed is critical and that the program should be restarted to ensure data integrity. If AE_CRITICAL_PHASE is *N*, restarting may not be necessary; however, as a general rule you should restart even if AE_CRITICAL_PHASE is set to *N*.

Using Restart at the Step Level

In the Where clause of a Do Select action in your program, you should include conditions that reduce the answer set returned from the Select statement.

For example:

```
SELECT RECNAME, FIELDNAME
   FROM PS_AE_RECFIELD
   ORDER BY RECNAME, FIELDNAME
```

If you ran this Select statement as part of a Do Select action with *Restartable* selected as the Do Select type, the system might process some of the rows twice after a restart. Also, if you specified *Reselect*, the program could execute in an infinite loop because no code exists to reduce the answer set. However, if you modified the Select statement as follows, you could make it *Restartable*:

```
SELECT RECNAME, FIELDNAME
   FROM PS_AE_RECFIELD
  WHERE RECNAME > %Bind(RECNAME)
   OR (RECNAME = %Bind(RECNAME) AND FIELDNAME > %Bind(FIELDNAME))
   ORDER BY RECNAME, FIELDNAME
```

You can convert a Do Select action that was coded for *Restartable* to *Select/Fetch*, but the opposite is not true.

The previous example shows the use of a key column to reduce the answer set. A key column can be convenient if your record has only one or two key fields; however, if your record has three or four keys, your SQL would become overly complex.

Instead of matching key fields, you could add a switch to the selected table and then have the processing of the called section modify the switch as it processes the row. In this example, your Select statement might look like this:

```
SELECT COLUMN1, COLUMN2, . . .
   FROM PS_TABLE1
   WHERE PROCESSING_SWITCH='N' . . .
```

Controlling Abnormal Terminations

A controlled abnormal termination (sometimes called an *abend*) means that Application Engine exits gracefully because of a calculated error condition. Examples of controlled abends are:

- SQL errors while On Error is set to *Abort*.
- A PeopleCode return value when On Return is set to *Abort*.
- A SQL statement that affects no rows when On No Rows is set to *Abort*.

In these situations (when Application Engine is in control), the Run Status field in Process Monitor reads *Error*.

An uncontrolled termination occurs when a memory violation occurs or a user terminates a process. In these cases, the Run Status field in Process Monitor reads *Processing*.

Restarting Application Engine Programs

You can restart an Application Engine program in one of these ways:

- From the command line.
- From a process request page.

Note. The following procedures for restarting a failed Application Engine program assume that you have rectified the error that caused the program to fail in the first place. For instance, suppose the name of a referenced table has changed. Regardless of how many times you restart the program, it will continue to fail until you modify all references to the old table name.

Restarting from the Command Line

Normally, only developers and system administrators use the command line for restarting Application Engine programs. Users, in most cases, should not be expected to use this method.

You can use the command line option to restart programs that run on the client or the server. Application Engine references only the process instance of the failed process. Therefore, if you run a process on the client and it fails, you can restart it from the server using the server command line. Likewise, if you run a process from the server and it fails, you can restart it from the client using the command line.

To restart an Application Engine program from the command line:

1. Collect the command line values associated with the failed program.

These values include database type, database name, user ID and password, run control ID, program name, and process instance. You can find these variables in the Process Details dialog box, the corresponding state record, or the Application Engine Run Control table. Where the values reside depends on how you invoked the program. For instance, if you invoked the program using the command line or from outside of PeopleSoft Process Scheduler, then you cannot view details associated with the program run in the Process Details dialog box.

2. Enter the following command line syntax at the command prompt, substituting the values from the previous step:

```
PSAE.EXE -CT DB_TYPE -CD DB_NAME -CO OPRID -CP PASSWORD -R
RUN_CONTROL -AI PROGRAM_NAME -I PROCESS_INSTANCE
```

Note. Some database platforms, such as Sybase, also require that you include a server name in the argument list.

Restarting from a Process Request Page

The only programs you can restart from a process request page are those that run on the server.

To restart an Application Engine program from a process request page:

1. Open PeopleSoft Process Scheduler by selecting PeopleTools, Process Scheduler, System Process Requests.
2. Locate the run control ID number of the program to restart.
3. To display the details of the failed process, click the Process Detail link.
4. On the Process Request Details page, select Restart Request and click OK.

Bad Restart Errors

If you attempt to restart a process that completed successfully according to Application Engine, you will receive a bad restart message. You will also get this message if your Application Engine application is defined with restart disabled.

Starting Application Engine Programs from the Beginning

When an Application Engine program ends abnormally, you may have to decide whether you should restart the process or start it from the beginning. As your Application Engine program ran at least part way through, starting over may leave your data in an unknown state. Also, application logic might need to be undone, depending on the stage of the program when it failed, what data the program had committed, and so on.

However, if restart is enabled and you attempt to start a new process that matches the run control ID and user ID for another process, then you receive a suspend error. Because the process instance for these two processes is different, the new request fails. This event usually occurs when a user tries to run the program again after receiving an error on the previous attempt.

To start the program over from the beginning, you can use SQL to delete the row that corresponds to the failed program from the Application Engine run control table and your state record.

To restart an Application Engine program from the beginning:

1. Open your native SQL editor and manually delete the row in PS_AERUNCONTROL that corresponds to the program you want to start from the beginning.

Use the following SQL to accomplish this step:

```
DELETE FROM PS_AERUNCONTROL
WHERE OPRID=OPRID
AND RUN_CNTL_ID=Run_Control_ID
```

2. Delete from your state record the row that corresponds to the failed program run.

Use the following SQL to accomplish this step:

```
DELETE FROM PS_MY_AET
WHERE PROCESS_INSTANCE=Process_Instance
```

Note. To restart the program, you can also select Restart Request from the Process Request Details dialog box.

Enabling and Disabling Restart

To disable restart, use any of these methods:

- Select the Disable Restart check box in the Application Engine Program Properties dialog box.

To access program properties, select File, Definition properties and select the Advanced tab.

- Select the Disable Restart check box in the Configuration Manager profile.

To access the profile, start Configuration Manager, select the Profile tab, and click Edit. Then select the Process Scheduler tab.

- Include the -DR Y option in the command line of PSAE.EXE.

If you disabled restart in any of these three places, restart is disabled.

If you want the program to restart in a production environment while still keeping a restart condition from getting in the way during development and testing, you can deselect the Disable Restart check box in the Application Engine program properties. Then, during development, you can select the Disable Restart check box in Configuration Manager or invoke your program from the command line with the -DR Y option without having to reconfigure the program for testing.

Caching the Application Engine Server

Application Engine caches metadata just like the application server. This caching enhances performance because a program can refer to the local cache for any objects that it uses.

Cache Directory Location

Application Engine programs that run on a Microsoft Windows NT or UNIX server lock their own cache directory for the duration of a run. You find these directories under the master cache directory. The master directory is created under the directory specified by the CacheBaseDir variable in the PeopleSoft Process Scheduler configuration file. If all existing cache directories are locked, a new one is created. Cache subdirectories are named sequentially, starting at 1.

If you do not enter a fully qualified path for the CacheBaseDir variable, then Application Engine creates a cache directory within the directory in which the program is set to run.

Note. Do not share the CacheBaseDir variable with application servers and do not use environment variables when specifying CacheBaseDir because the system does not resolve them. For example, do not set CacheBaseDir to \$PS_CFG_HOME.

Cache Parameters

The PSPRCS.CFG (PS_SERVER_CFG) file has two additional cache parameters. They are:

- Enable Server Caching
- Server Cache Mode

Do not alter these settings from the delivered defaults. These settings are reserved for future use.

Freeing Locked Temporary Tables

If you use dedicated temporary tables for Application Engine programs, then you might need to free, or unlock, a temporary table if the program running against it terminates abnormally. Because most Application Engine programs run through PeopleSoft Process Scheduler, typically you use Process Monitor to unlock the temporary tables. Deleting or restarting a process using Process Monitor automatically frees the locked temporary tables.

For the programs that you invoke outside of PeopleSoft Process Scheduler, use the Manage Abends page. Programs running outside of Process Scheduler include those invoked from CallAppEngine PeopleCode and the command line.

To free locked temporary tables using the Manage Abends page:

1. Select PeopleTools, Application Engine, Manage Abends.
2. Identify the program that has locked the temporary tables you want.

Use the process instance, run control ID, program name, user ID, and run date and time columns to uniquely identify programs.

3. Click the Temp Tables link.
4. On the Temporary Tables page, click the Release button to unlock the temporary tables associated with the program.

Chapter 7

Calling Application Engine Programs from COBOL

To facilitate the conversion of existing COBOL programs to Application Engine programs, you can call Application Engine programs from existing COBOL code.

This chapter discusses how to:

- Add copybooks to COBOL programs.
- Assign copybook values.
- Handle COBOL errors.

Adding Copybooks to COBOL Programs

To enable you to call Application Engine programs from COBOL programs, include the copybook called PTCCBLAE.CBL with your COBOL programs. This copybook is located in *PS_HOME*\src\cbl\base.

The following is the PTCCBLAE.CBL copybook:

```

*01  CBLAE .

NOCLN      02  CBLAE-PRCSNAME          PIC X(12)    VALUE SPACE .
NOCLN      02  CBLAE-COMMIT-FLAG      PIC X(1)    VALUE SPACE .
           88  AE-COMMITS-SUCCESS    VALUE 'B' .
           88  AE-COMMITS-ALL        VALUE 'C' .

           02  CBLAE-PARMS .
               03  CBLAE-PARM-CNT      PIC 9(4)          COMP .
               03  CBLAE-PARM-ENT      OCCURS 500 TIMES .
                   05  CBLAE-STATEREC  PIC X(15) .
                   05  CBLAE-FIELDNM   PIC X(18) .
                   05  CBLAE-DATA-PTR  POINTER .
                   05  CBLAE-LENGTH   PIC 9999          COMP .
                   05  CBLAE-SCALE    PIC 99           COMP .
NOCLN      05  CBLAE-TYPE             PIC X .
           88  CBLAE-TYPE-CHAR        VALUE 'C' .
           88  CBLAE-TYPE-SMALLINT    VALUE 'S' .
           88  CBLAE-TYPE-INT         VALUE 'I' .
           88  CBLAE-TYPE-DEC         VALUE 'P' .
           88  CBLAE-TYPE-DATE        VALUE 'D' .
           88  CBLAE-TYPE-TIME        VALUE 'T' .
           88  CBLAE-TYPE-TIMEONLY    VALUE 'V' .
           88  CBLAE-TYPE-NUMERIC     VALUE 'S' 'I' 'P' .
    
```

Data Transfer Process Between COBOL Programs and Application Engine Programs

To interface between COBOL programs and Application Engine programs, the process uses a file to pass parameters from COBOL to the Application Engine program. This file is owned by the process and has the *prm* extension. The location of the file is determined by the following:

- If an application server root directory is defined, then the file resides in the output directory of that particular process instance.
- If the output directory on the application server is not defined, then the file resides in the default output directory of the Process Scheduler domain.
- If neither of the above is defined, then the file is written to the default temp directory.

Assigning Copybook Values

To assign values to the copybook of the calling COBOL program to be passed as parameters into the state records of the called Application Engine program:

- Identify the fields in your COBOL program that contain the values you want to pass to the Application Engine program.
- Load the PTCCBLAE.CBL copybook with the state record name, field name, field length (this should be the size of the field not the size of the contents), the scale (decimal places if any), and set the field type.
- Call the PTPSETAD program to set the pointer in PTCCBLAE.CBL to the host programs variable.
- Set the variable *AE-COMMIT-FLAG* to either *AE-COMMITS-ALL* or *AE-COMMITS-SUCCESS*.

AE-COMMITS-ALL means that the Application Engine program commits as specified in the program. *AE-COMMITS-SUCCESS* means that the Application Engine program ignores all commits and performs one commit at the end of successful execution.

Example of Loading Values from PTPSTAE.CBL Sample Program

Make sure the calling COBOL program has connected successfully to the database before calling the PTPCBLAE copybook. Also ensure that the calling program is not running through a RemoteCall function.

This code is an example of how to load values from the copybook:

```

MOVE 0 TO CBLAE-PARM-CNT OF CBLAE

      ADD 1 TO CBLAE-PARM-CNT OF CBLAE
MOVE 'QE_CBLAETST_AET' TO CBLAE-STATEREC
      OF CBLAE (CBLAE-PARM-CNT OF CBLAE)
MOVE 'DESCR' TO CBLAE-FIELDNM
      OF CBLAE (CBLAE-PARM-CNT OF CBLAE)
MOVE 30 TO CBLAE-LENGTH
      OF CBLAE (CBLAE-PARM-CNT OF CBLAE)
MOVE 0 TO CBLAE-SCALE
      OF CBLAE (CBLAE-PARM-CNT OF CBLAE)
SET CBLAE-TYPE-CHAR OF CBLAE (CBLAE-PARM-CNT OF CBLAE)
      TO TRUE
CALL 'PTPSETAD' USING CBLAE-DATA-PTR
      OF CBLAE (CBLAE-PARM-CNT OF CBLAE)
      W-DESCR OF W-WORK

      ADD 1 TO CBLAE-PARM-CNT OF CBLAE
MOVE 'QE_CBLAETST_AET' TO CBLAE-STATEREC
      OF CBLAE (CBLAE-PARM-CNT OF CBLAE)
MOVE 'QE_AE_INT_7' TO CBLAE-FIELDNM
      OF CBLAE (CBLAE-PARM-CNT OF CBLAE)
MOVE 2 TO CBLAE-LENGTH
      OF CBLAE (CBLAE-PARM-CNT OF CBLAE)
MOVE 0 TO CBLAE-SCALE
      OF CBLAE (CBLAE-PARM-CNT OF CBLAE)
SET CBLAE-TYPE-SMALLINT
OF CBLAE (CBLAE-PARM-CNT OF CBLAE)
      TO TRUE
CALL 'PTPSETAD' USING CBLAE-DATA-PTR
      OF CBLAE (CBLAE-PARM-CNT OF CBLAE)
      W-SMINT OF W-WORK

```

*

```
DA000-CALL-AE SECTION.
```

```
DA000.
```

```
*
```

```
MOVE 'QE_AETESTPRG' TO CBLAE-PRCSNAME OF CBLAE
```

```
SET AE-COMMITS-ALL TO TRUE
```

```
CALL 'PTPCBLAE' USING SQLRT CBLAE.
```

```
CALL-AE-EXIT.
```

```
EXIT.
```

Sample of the Communication Area of PTPBLAE.CBL

If the called Application Engine program updated the state records or fields that were passed by PTPCBLAE, then the fields or records are stored in the local variables of the calling program, as identified by PTPSETAD:

```

* PTCCLAE - Communication area for PTPCLAE
*
*01 CBLAE.
NOCLN 02 CBLAE-PRCSNAME PIC X(12) VALUE SPACE.
* Name of AE program to be called.
NOCLN 02 CBLAE-COMMIT-FLAG PIC X(1) VALUE SPACE.
* Flag to determine which of the following commits to make.
      88 AE-COMMITS-SUCCESS VALUE 'B'.
* No in-process commit; if successful, then commit occurs.
      88 AE-COMMITS-ALL VALUE 'C'.
* Commits occur when defined in the AE program.
      02 CBLAE-PARMS.
          03 CBLAE-PARM-CNT PIC 9(4)COMP.
* Counter of the number of state records passed.
          03 CBLAE-PARM-ENT OCCURS 500 TIMES.
* Maximum value of state record entries.
          05 CBLAE-STATEREC PIC X(15).
* State record name.
          05 CBLAE-FIELDNM PIC X(18).
* Field name.
          05 CBLAE-DATA-PTR POINTER.
* Pointer to your own working storage area.
          05 CBLAE-LENGTH PIC 9999 COMP.
* Field length of defined state record.
          05 CBLAE-SCALE PIC 99 COMP.
* Number of decimal places.
NOCLN 05 CBLAE-TYPE PIC X.
* Field data type.
      88 CBLAE-TYPE-CHAR VALUE 'C'.
      88 CBLAE-TYPE-SMALLINT VALUE 'S'.
      88 CBLAE-TYPE-INT VALUE 'I'.
      88 CBLAE-TYPE-DEC VALUE 'P'.
      88 CBLAE-TYPE-DATE VALUE 'D'.

```

```
88  CBLAE-TYPE-TIME           VALUE 'T' .
88  CBLAE-TYPE-TIMEONLY      VALUE 'V' .
88  CBLAE-TYPE-NUMERIC       VALUE 'S' 'I' 'P' .
```

Handling COBOL Errors

If your COBOL program needs error handling, try the following procedure:

1. Add a field (return code) to your state record.
2. Initialize the field to a negative value.
3. Pass the value into the Application Engine program.
4. At the successful completion of the Application Engine program, change the field value to a positive value.
5. Check for that value in your COBOL program.

Chapter 8

Tracing Application Engine Programs

This chapter provides overviews of tracing Application Engine programs and trace results and discusses how to:

- Enable Application Engine tracing.
- Locate trace files.

Understanding Tracing Application Engine Programs

You can set the following traces to monitor the performance of Application Engine programs:

- Application Engine step trace.
- Application Engine SQL trace.
- Application Engine statement timings trace.
- Database optimizer trace.

Note. The general PeopleTools SQL and PeopleCode traces also apply to Application Engine programs.

Understanding Trace Results

This section discusses:

- Trace file sections.
- Step traces.
- SQL traces.
- Statement timings traces.
- Database optimizer traces.

Trace File Sections

At the top of each trace, useful information helps you to identify the PeopleTools version, the database name, and the database platform type.

SQL Counts and Timings Section

The first section of a trace file is the SQL section. It records the performance of application-specific SQL. The trace values appear within a series of columns and sections. The following table describes each column within the first section of the trace file:

Column	Description
SQL Statement	Application Engine SQL actions and stored SQL objects always have a statement ID. The SQL Statement column shows the statement ID so that you can attribute trace values to individual SQL statements. In the case of SQLExec SQL, a portion of the SQL statement appears in the first column to help you identify it. For SQL objects, use the TraceName property in the Create SQL so that you can uniquely identify it in the traces.
Compile Column	This column shows how many times the system compiled a SQL statement and how long the compilation took. The term <i>compiled</i> refers to the SQL statement being sent to the database to be parsed and optimized, and it also includes the time required for the first resolution of any PeopleSoft meta-SQL.
Execute Column	This column shows how many times the system executed the SQL statement and the time consumed doing so. The term <i>executed</i> refers to the system sending the compiled SQL to the database server to be run against the database.
Fetch Column	This column applies to Select statements. It shows how many rows your program fetched from the database and how much time this consumed. The system must first execute a Select statement against the database to find the relevant rows and generate an active set. After the set exists, the program must still fetch the rows. Some database APIs have buffered fetches, which means that the fetch may include more than one row. Therefore, subsequent fetches are free until the buffer becomes empty.
Total Column	This column shows the sum of the compile, execute, and fetch times of the SQL statement. Some database application programming interfaces (APIs may defer a compile to the execute phase or defer an execute to the first fetch operation.
PeopleCode SQL	This subsection is for SQL run from PeopleCode actions. Compile counts and times for such SQL is included in execute count and times because you do not explicitly control the ReUse feature. To determine whether ReUse is occurring, you must do a program run after enabling the generic PeopleTools trace for SQL statements, API calls, and so on. As a starting point, use a trace value of 31.

Column	Description
Application Engine SQL	This subsection reveals the time attributed to Application Engine overhead that is not directly related to the SQL within your program. For example, the values in this section represent the SQL generated for checkpoints, commits, and so on. If there are Commit statements without checkpoints, it indicates that restart has been disabled, or a restartable program has called a non-restartable program. If the time consumed performing a checkpoint or committing seems more than expected, you should try to reduce it if possible by setting the commit frequency of the steps containing Do loops.
AE Program: <i>program_name</i>	This subsection shows SQL actions for a particular program. The action properties that affect performance are flagged. For example, BulkInsert. ReUse is not flagged because it is self-evident when the Execute count is higher than the compile count.

Note. When you run a SQL trace at the Application Engine level and the PeopleTools level simultaneously, you may see misleading results. Extra overhead is added to the overall SQL timings by the PeopleTools trace. Tracing SQL at the Application Engine level (-TRACE) adds to the non-SQL times because PeopleTools writes the trace data after timing the SQL.

PeopleCode Actions Section

The second section of the trace file, or PeopleCode section, records the performance associated with all the PeopleCode actions in your program. The following table describes each column in this section:

Column	Description
PeopleCode	The names of the PeopleCode actions in your program.
Call	How many times each PeopleCode action is called during a program run.
Non-SQL	The time spent running non-SQL actions.
SQL	Time spent running SQL. The total SQL time should be similar to that of the PeopleCode SQL subsection in the first section of the trace file.
Total	The cumulative amount of time spent on an action.

Note. The system rounds to the first decimal place (tenths), but only after it calculates the sum of each action time.

PeopleCode Built-ins and Methods Section

The third section of the trace file contains either a list or summary of the PeopleCode built-ins and methods used. To see a list of built-ins and methods, you must enable the PeopleCode detail timings in addition to the statement timings trace.

If a method or built-in function takes a large amount of time, you may want to consider alternatives. For example, if array processing dominates your runtime, consider inserting the data into temporary tables and performing the processing on tables in the database.

Summary Data

The fourth section of the trace file contains summary data. The values in this section provide an overview of the program run without providing too many details.

The following table describes the values that appear in this section:

Column	Description
Total run time	The overall amount of time a program required to complete from start to finish.
Time in application SQL	The time that your program spent executing SQL. This value includes SQL run by both PeopleCode and SQL actions.
Percent time in application SQL	The percentage of time spent running SQL compared to the entire program run.
Time in PeopleCode	The time the program spent running PeopleCode. Time in PeopleCode excludes SQL run from within PeopleCode.
Percent time in PeopleCode	The percentage of time spent running PeopleCode compared to the entire program run.
Total time in Cache	The amount of time the program spent retrieving objects from the cache or refreshing the cache. Total time in cache includes all memory cache access, file cache access, and SQL run to load managed objects such as Application Engine program components, metadata, and so on. Time varies according to where Application Engine finds an object. For instance, retrieving an object that the system cached during a previous run is faster than retrieving it from the database.
Number of calls to Cache	The actual number of calls the program made to the cache. The number of calls to the cache remains constant for the same Application Engine program processing the same data.

Environment Information Section

The fifth section of the trace file contains environment information specific to Application Engine. If programs appear to be performing poorly, check the trace value that you set.

Each trace produces an unavoidable degree of overhead. As a result, the more traces you have enabled, the more likely you are to see degraded performance. Run only the traces you need. This section of the trace file shows information about:

- SQL traces.

- PeopleCode traces.
- Application Engine traces.
- Application Engine DbFlags (%UpdateStats).

Step Traces

A step trace reports each step name that your program runs and the order it runs in. Associated with each step is a timestamp, a Do action level, and an action type.

The trace shows the steps that run within a called section by indented formatting. For example, a step that runs within a called section is preceded by two dots (..), while other steps are preceded by only one dot (.).

SQL Traces

The SQL trace report shows formatted SQL processes, including commits, rollbacks, and restarts. You can also view the buffers associated with each SQL statement. Use a SQL trace to spot errors in your SQL and to view your commit strategy.

Statement Timings Traces

The Application Engine statement timing trace report is similar to a COBOL timings trace in which you monitor COBOL programs to evaluate performance. This trace enables you to gather performance information to determine where program performance slows down. After you identify these spots, you might be able to modify your program to run more efficiently, or you might want to change the database schema and configuration to optimize program performance.

The statement timings trace is invaluable for tuning an Application Engine program. It may also be useful as a default trace level for all production runs to provide a metric for long-term performance trends.

By examining all of the figures in this trace, you can identify areas of your program that are not running as efficiently as possible. For instance, if compile counts are high, you can reduce the numbers by using the Application Engine reuse feature. If inserts appear to be running slow and you have many of them, you can increase performance by using the Application Engine bulk insert feature. Each value in the trace, including cumulative totals, is rounded to the nearest tenth of a second, but totals are calculated using nonrounded timings.

You can write this trace to a file or you can write the results to tables. Either way, timings trace overhead is minimal. Internal testing reveals that the Application Engine trace has an overhead between 2 percent and 5 percent of total runtime.

By storing timings information in a table, you can store historical data in the database, which enables you to produce reports that help with trend analysis, allow ad hoc SQL queries for longest running statements, and so on. By storing timings data in the database, you can manipulate and customize reports to show only the metrics in which you are most interested.

You can use third-party tools to query and present the data as detailed graphical representations of program performance. You can also implement alarms if the performance of a program reaches a specified maximum value in a particular area, such as SQL compile time.

Note. Application Engine does not write the timings trace to a table for programs invoked by the CallAppEngine PeopleCode function. To write to a table, a process instance is required, and programs invoked by CallAppEngine are not assigned a process instance.

The Statements Timings (table) option, or 1024 -TRACE option, populates the following tables.

- PS_BAT_TIMINGS_LOG (Parent)
This table stores general information about a program run.
- PS_BAT_TIMINGS_DTL (Child)
This table stores detailed information about a program run, such as the execute count, fetch time, and so on.

The SQL Timings (table) option, or the 16834 -TRACE option, populates the following tables.

- PS_AE_TIMINGS_LG (Parent)
This table stores general information about a program run.
 - PS_AE_TIMINGS_DT (Child)
This table stores detailed information about a program run, such as the execute count, fetch time, and so on.
- PS_BAT_TIMINGS_FN
This table stores PeopleCode detailed timing information.

PeopleSoft software provides BATTIMES.SQR as an example of the type of reports you can generate to reflect the information stored in the BAT_TIMINGS tables. You can produce a summary report for all the programs for a specific run control ID, or you can get detailed data for a specific process instance.

To invoke the BATTIMES.SQR report through PeopleSoft Process Scheduler:

1. Select PeopleTools, Process Scheduler, Batch Timings.
The Batch Timings page appears.
2. From the Report Type drop-down list, select *Detail* or *Summary*.
3. In the Batch Timings For group box, enter the run control ID for summary reports and enter the process instance for detail reports.
4. When you have made the appropriate selections, click the Run button.

To view batch timings using Process Monitor:

1. Select PeopleTools, Process Scheduler, Process Monitor.
2. Locate the program run associated with the current trace.
3. Click the Job Details button.
4. In the Process Detail dialog box, click the Batch Timings link.

PeopleCode detail timings do not appear; they appear only in the file format.

Database Optimizer Traces

The database optimizer trace provides the execution or query plan for the SQL that your Application Engine program generates. Each SQL statement is traced only once. You can write the trace to a file or a table.

How you view the results of this trace depends on the relational database management system (RDBMS) that you are currently using. For instance, on some platforms only the trace-to-file option is available, whereas on others only the trace-to-table option is available. The following table shows the options available for each of the supported platforms:

RDBMS	Output
Oracle	File and table
DB2 for OS/390	Table
DB2 for UDB (AIX, Sun Solaris, Microsoft Windows NT)	Table
Microsoft SQL Server	File and table
Informix	File
Sybase	N/A

Note. PeopleTools applications do not collect optimizer data for SQL originating from PeopleCode actions unless you run Oracle and Informix and use file output. In this case, the system traces all SQL that runs after the first SQL action runs.

Oracle

When sending the trace to a file, Application Engine writes the trace file to the default Oracle trace directory specified on the database server. To read the trace file, use the TKPROF utility.

To send the trace to a table on Oracle, a PLAN_TABLE table must exist and the statement_id must be of type VarChar2(254) instead of VarChar2(30).

When sending to a table, the PeopleSoft application updates the trace rows as follows:

- For the EXPLAIN PLAN SET STATEMENT_ID, PeopleSoft software updates the STATEMENT ID column:

```
EXPLAIN PLAN SET STATEMENT_ID = ApplId.Section.Step.Type FOR sqlstmt
```

- or the PLAN_TABLE REMARKS column, PeopleSoft software updates the REMARKS column:

```
PLAN_TABLE's REMARKS column = 'ProcessInstance-RunControlId(QueryNo)'
```

Where *queryno* is a count of how many SQL statements have been traced up to a particular point.

Note. When tracing to a table with Oracle, PeopleSoft software does not perform optimizer traces on %UpdateStats and %TruncateTable unless the latter resolves into a Delete statement. Alternatively, sending the Oracle TKPROF utility to a file handles both the Analyze and Truncate commands.

Microsoft SQL Server

When you send trace output to a file, Application Engine writes the optimizer trace to the following location: %TEMP%\psms<queueid><spid>.trc. To read the trace, use the SQL Server Profiler utility.

Note. The system writes the trace file to the server directory when you specify the trace on the client. If the client has %Temp% set to a drive or directory that does not exist on the server, then Application Engine does not generate a trace file.

When you send trace output to a table, Application Engine writes the trace data to the dbo.PS_OPTIMIZER_TRC table. PeopleTools creates the table automatically when you run the trace for the first time. The trace data written to the table is identical to the data that appears in the optimizer trace file.

You use the SQL Server Profiler utility to view the optimizer results. To view the populated trace table, specify the current server and database in the Source Table dialog box. The Owner value must be *dbo*, and the Table value must be *PS_OPTIMIZER_TRC*.

In the trace, you find information about text, duration, and start time for:

- Execution plans.
- Remote procedure calls.
- Insert statements (Update, Delete, and Select statements).
- PeopleSoft-generated user events that associate trace data with a PeopleSoft SQL identifier.

If the Application Engine program terminates while you are using the trace option, verify that Application Engine was not tracing a SQL statement at the moment the program terminated. If it was tracing a SQL statement at that time, you must manually stop the trace. Otherwise, the trace thread on the server continues to run and will lock the trace file, and each time that server process ID (SPID) is reused by the server, new information will be appended to the locked trace file.

To stop the trace manually, submit the following command from Query Analyzer:

```
xp_trace_destroyqueue queueid
```

The *queueid* variable in the file name %TEMP%\psms_*queueid*_spid.trc is the ID that corresponds to the queue used for the first SQL statement that the system profiled. Because this trace is only designed to trace Application Engine SQL (not PeopleTools SQL), the queue is closed after every statement profiled. Therefore, the queue that must be destroyed may not be the queue ID used in the trace file.

Note. If the %TEMP% variable is set to a location that does not exist, Application Engine does not generate a trace file.

Informix

For Informix, you can only send the trace to a file. The trace file location depends on the operating system on which your database server runs:

- UNIX

For UNIX, Application Engine writes the plan to the sqexplain.out file. If the client program runs on the same machine as the database server, then the sqexplain.out file appears in the current directory. When the current database is on another computer, the sqexplain.out file is written to the PeopleSoft owner's directory on the remote host.

- Microsoft Windows NT

For Microsoft Windows NT, Application Engine writes the plan to the INFORMIXDIR%\sqexpln\username.out file.

DB2 for OS/390

For DB2 for OS/390, you can only send the optimizer trace to a table. To facilitate this trace:

- The PeopleSoft application selects the maximum query number from the PLAN_TABLE table, increments it by 1000 to avoid clashing with other processes, and then increments it by 1 for every SQL statement traced.
- The PeopleSoft application sets the SET REMARKS parameter to this value: ApplId.Section.Step.Type-RunControlId(ProcessInstance)

Note. Before using the Database Optimizer Trace, you must first create a DB2 PLAN_TABLE. Refer to your DB2 UDB for OS/390 and z/OS Administration Guide for the correct format and instructions for creating the PLAN_TABLE.

DB2 for UNIX

For DB2 for UNIX, you can only send the optimizer trace to a table. To facilitate this trace, we implemented:

```
EXPLAIN ALL SET QUERYNO =ProcessInstance SET QUERYTAG = 'Section.Step' FOR sql stmt
```

Note. Before using the Database Optimizer Trace, you must first create the DB2 explain tables.

Database Optimizer Trace and Performance

While the database optimizer trace is enabled, performance may be affected. Typically, you turn on this trace only when you are collecting detailed performance metrics. When you are not tuning system performance, turn off the optimizer trace.

To prevent an administrator or perhaps a user from unwittingly turning the optimizer trace on or leaving it on after doing performance tuning, you can disable the database optimizer trace for an entire database.

For example, if you have a production database and a development database, you might want to enable the optimizer trace for the development database but disable it for the production database.

On the PeopleTools Options page, clear the Allow DB Optimizer Trace option to disable the optimizer trace for a database.

Enabling Application Engine Tracing

By default, all Application Engine traces are turned off. To see a trace or a combination of traces, set trace options before you run a program.

This section discusses how to:

- Set command line options.
- Set parameters in server configuration files.
- Set options in Configuration Manager.

Setting Command Line Options

The command line option is available for Microsoft Windows NT and UNIX, but it is not available when calling Application Engine programs from PeopleCode.

To enable tracing from the command line, specify the `-TRACE` option within the command line that you submit to `PSAE.EXE`. For example:

```
n:\pt840\bin\client\winx86\psae.exe -CT MICROSOFT -CD PT800GES -CO PTDMO?
  -CP PTDMO -R PT8GES -AI AETESTPROG -I 45 -TRACE 2
```

The following table describes the available `TRACE` option parameter values:

<i>Value</i>	<i>Description</i>
0	Disables tracing.
1	Initiates the Application Engine step trace.
2	Initiates the Application Engine SQL trace.
4	Initiates the trace for dedicated temporary table allocation to an Application Engine trace (AET) file. You can trace how the system allocates, locks, and releases temporary tables during program runs.
128	Initiates the statement timings trace to a file, which is similar to the COBOL timings trace to a file.
256	Initiates the PeopleCode detail to the file for the timings trace.
1024	Initiates the statement timings trace and stores the results in the <code>PS_BAT_TIMINGS_LOG</code> and <code>PS_BAT_TIMINGS_DTL</code> tables.
2048	Requests a database optimizer trace file.

Value	Description
4096	Requests a database optimizer to be inserted in the Explain Plan table of the current database.
8192	Sets a trace for PeopleSoft Integration Broker transform programs.
16384	Initiates a SQL timings trace and stores the results in the PS_AE_TIMINGS_LG and PS_AE_TIMINGS_DT tables.

To specify traces on the command line, you enter the sum of the desired trace options. This action is similar to adding the trace values using PSADMIN, such as the COBOL statement timings or the SQL statement trace value. To specify a combination of traces, enter the sum of the corresponding trace values. For example, to enable the step (1), the SQL (2), and the statement timings (128) traces, you would enter 131, which is the sum of 1 + 2 + 128.

To disable tracing, explicitly specify `-TRACE 0`. If you do not include the `-TRACE` flag in the command line, Application Engine uses the value specified in the Process Scheduler configuration file or in Configuration Manager. Otherwise, the command-line parameters override any trace settings that may be set in Configuration Manager.

Setting Parameters in Server Configuration Files

You can also enable traces in the configuration files for both the application server and the PeopleSoft Process Scheduler server.

For programs invoked by PeopleCode and run on the application server, set the TraceAE parameter in the Trace section of the Application Server configuration file (PSAPPSRV.CFG). You can use PSADMIN to set this parameter.

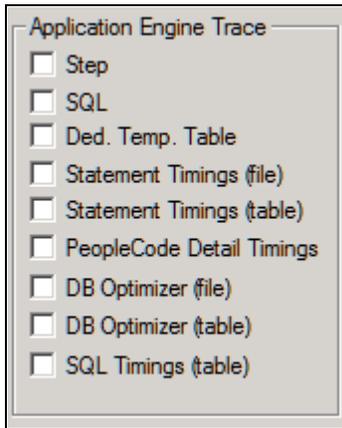
In the PeopleSoft Process Scheduler configuration file, set the TraceAE parameter in the Trace section to indicate a level of tracing. You can use PSADMIN to set this parameter.

This option is available on Microsoft Windows NT and UNIX, and it applies only to Application Engine programs invoked in batch mode.

Note. The TraceFile parameter does not specify the location of the Application Engine trace file; it applies only to the generic PeopleTools SQL and PeopleCode traces.

Setting Options in PeopleSoft Configuration Manager

For processes running on a Microsoft Windows workstation, you can set trace options using PeopleSoft Configuration Manager. This procedure is valid only if you are running Application Engine programs on a Microsoft Windows workstation in a development environment.



Application Engine Trace check boxes

To set Application Engine traces:

1. Start Configuration Manager, and select the Trace tab.
2. Select the appropriate trace options.

You can select any combination of options.

3. Click either the Apply or OK button to set trace options.

Locating Trace Files

Locating a generated trace file depends on how you invoked the program and the operating system on which the program runs. This table describes trace file locations based on where the program initiated:

<i>Location Where the Program Was Initiated</i>	<i>Trace File Location</i>
Microsoft Windows workstation	Look for the trace file in %TEMP%\PS\ <db name>.<="" td=""> </db>
PeopleCode	Look for the trace file in %TEMP%\PS\ <i>db_name</i> on Microsoft Windows NT and in <i>PS_CFG_HOME</i> /log/\<db name> on UNIX and Linux systems.
Command line	Look for the trace file in the directory specified in the Log/Output field in the PS_SERVER_CFG file.
PeopleSoft Process Scheduler	Look for the trace file in a subdirectory of the directory specified in the Log/Output field in the PS_SERVER_CFG file.

When a program includes a process instance, Application Engine names the trace file according to this convention: *AE_Program_name_Process_Instance.AET*. When a program does not include a process instance, Application Engine names the file according to this convention: *AE_Date/Time_Stamp_OS_PID.AET*. The date and time stamp is in the format <month><day><hour><minute><second>, with two values for each date element and no punctuation between the elements. For example, August 12 at 5:09 p.m. and 30 seconds would be 0812170930.

Note. For an Application Engine program running on a server, PeopleTools writes the generic PeopleTools trace for SQL and PeopleCode trace files to the same directories as the AET traces. The prefix of the trace file name is also the same, and the suffix is *trc*. On a Windows workstation, the system writes the trace to the file specified in the People Tools Trace File field on the Trace tab of PeopleSoft Configuration Manager.

Chapter 9

Using Temporary Tables

This chapter provides an overview of temporary tables and discusses how to:

- Create temporary table instances.
- Manage temporary table instances.
- Make external calls.
- View temporary table usage.

Understanding Temporary Tables

Because Application Engine programs run in batch mode, multiple instances of the same program often execute in parallel. When this happens, the risk of data contention and deadlocks on tables is significant. To avoid this risk, you can dedicate specific instances of temporary tables for each program run.

You can also use temporary tables to improve performance. For example, if you find that, multiple times during a run the program accesses a small subset of rows from a much larger table, you can insert the necessary rows into a temporary table as an initialization task. Then the program accesses the data residing in the smaller temporary table rather than the large application table. This technique is similar to reading the data into an array in memory, except that the data never leaves the database, which is an important consideration when the program employs a set-based processing algorithm.

Any number of programs, not just Application Engine programs, can use temporary table definitions. When you specify a temporary table on the Temp Tables tab in the Application Engine program properties, Application Engine automatically manages the assignment of temporary table instances. When Application Engine manages a dedicated temporary table instance, it controls the locking of the table before use and the unlocking of the table after use.

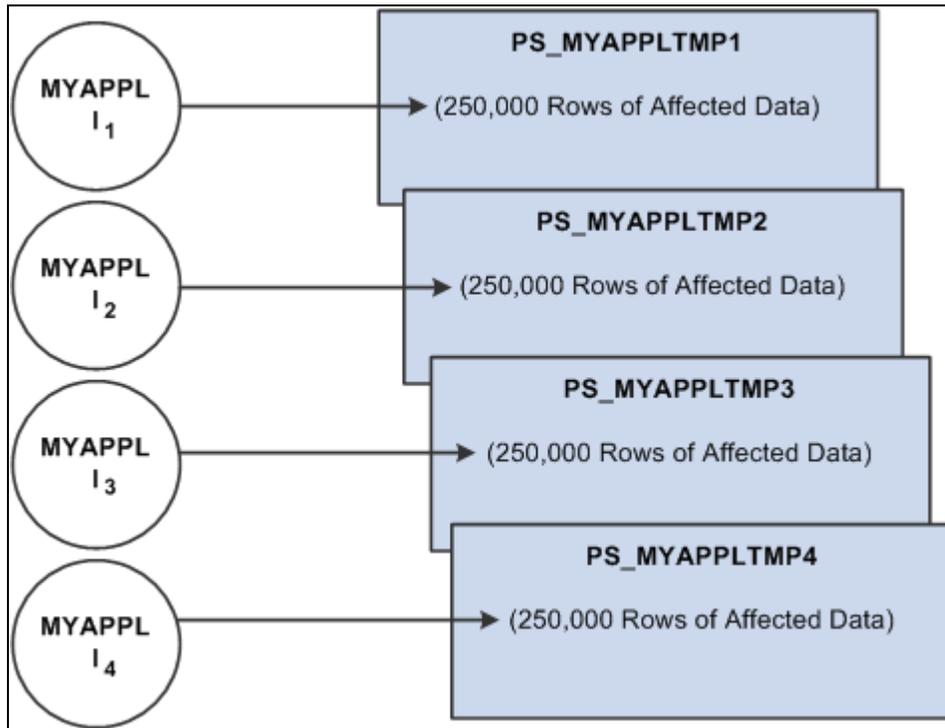
Parallel Processing

Parallel processing is used when considerable amounts of data must be updated or processed within a limited amount of time or a batch window. In most cases, parallel processing is more efficient in environments containing multiple CPUs and partitioned data.

To use parallel processing, partition the data between multiple concurrent runs of a program, each with its own dedicated version of a temporary table (for example, PS_MYAPPLTMP). If you have a payroll batch process, you could divide the employee data by last name. For example, employees with last names beginning with A through M are inserted into PS_MYAPPLTMP1; employees with last names beginning with N through Z are inserted into PS_MYAPPLTMP2.

To use two instances of a temporary table, you would define your program (for example, MYAPPL) to access one of two dedicated temporary tables. One run would use A through M and the other N through Z.

The Application Engine program invokes logic to pick one of the available instances. After each program instance is matched with an available temporary table instance, the %Table meta-SQL construct uses the corresponding temporary table instance. Run control parameters passed to each instance of the MYAPPL program enable it to identify which input rows belong to it, and each program instance inserts the rows from the source table into its assigned temporary table instance using %Table. The following diagram illustrates this process:



Multiple program instances running against multiple temporary table instances

No simple switch or check box enables you to turn parallel processing on and off. To implement parallel processing, you must complete the following task. With each step, you must consider details about your specific implementation.

1. Define and save temporary table records in Application Designer.

You do not need to run the SQL Build process at this point.

2. In Application Engine, assign temporary tables to Application Engine programs, and set the instance counts dedicated for each program.

Employ the %Table meta-SQL construct so that Application Engine can resolve table references to the assigned temporary table instance dynamically at runtime.

3. Set the number of total and online temporary table instances on the PeopleTools Options page.
4. Build temporary table records in Application Designer by running the SQL Build process.

Creating Temporary Table Instances

This section provides an overview of temporary table instances and discusses how to:

- Define temporary tables.
- Set the number of temporary table instances.
- Build table instances.

Understanding Temporary Table Instances

To run processes in parallel, you need to enable multiple instances of the same temporary table. You use the PeopleTools Options page to set the number of temporary table instances for Application Engine processes started online from the PeopleCode CallAppEngine function.

This global setting is separate from the instance count setting for a particular program. To use a temporary table with a specific program, you assign the table to the program and set the number of instances created when a particular program is run.

Key Fields for Temporary Tables

To take advantage of multiple instances of a temporary table, use the Temporary Table record type.

Insert the PROCESS_INSTANCE field as a key on any temporary tables that you intend to use with Application Engine. Application Engine expects Temporary Table records to contain the PROCESS_INSTANCE field.

Note. When all instances of a temporary table are in use and the Continue runtime option on the Program Properties dialog box Temp Table tab is selected, PeopleTools inserts rows into the base table using PROCESS_INSTANCE as a key. If you do not include PROCESS_INSTANCE as a key field in a temporary table, select the Abort Temp Table tab runtime option.

Temporary Table Performance Considerations

When you run batch processes in parallel, there is a risk of data contention and deadlocks on temporary tables. To avoid this, Application Engine has a feature that enables you to dedicate specific instances of temporary tables for each process. When Application Engine manages a dedicated temporary table instance, it controls the locking of the table before use and the unlocking of the table after use.

When you decide on the number of instances for temporary tables for a process, you must consider the number of temporary tables that the process uses. The more instances you have, the more copies of the temporary tables you will have in your system. For example, if a process uses 25 temporary tables and you have 10 instances for a process, then you will have 250 temporary tables in your system.

On the other hand, if you are running a process in parallel and all of the dedicated temporary table instances are in use, processing performance will be slower. Therefore, you will need to find a balance that works for your organization.

If you need more temporary table instances after you have entered production, you must rebuild all of your temporary tables so that the database reflects the proper inventory of instances. While the build process runs, users cannot access the database. Because of this, spend time deriving adequate estimates as to the number of temporary tables required.

A physical table within the database, named PS_AEONLINEINST, stores online temporary table instance usage. If you notice performance issues related to online Application Engine program runs, enable the Application Engine SQL and Timings trace.

If the following SQL command requires more time than normal to complete, then the number of online temporary instances defined on the PeopleTools Options page is probably insufficient.

```
UPDATE PS_AEONLINEINST . . .
```

Defining Temporary Tables

To define a temporary table:

1. In Application Designer, select File, New.
2. Select Record from the New Definition dialog box.
3. Select Insert, Field, and insert the PROCESS_INSTANCE field.
4. Select the Record Type tab and select the Temporary Table option.

Setting the Number of Temporary Table Instances

Select PeopleTools, Utilities, Administration, PeopleTools Options to access the PeopleTools Options page.

PeopleTools Options

Environment Long Name: Environment Short Name:

System Type:

Language Settings

Language Code: *Sort Order Option:

Translations Change Last Update

Background Disconnect Interval:

Multi-Company Organization

Multi-Currency

Use Business Unit in nVision

Use Secure Rep Rqst in nVision

Multiple Jobs Allowed

Allow DB Optimizer Trace

Grant Access

Platform Compatibility Mode

Allow NT batch when CCSID<>37

Save Error is Fatal

Set Focus on Save Button

Temp Table Instances (Total):

Temp Table Instances (Online):

*Maximum Message Size:

Base Time Zone:

Last Help Context # Used:

*Data Field Length Checking:

*Maximum Attachment Chunk Size:

Upgrade Project Commit Limit:

*Enable Switch User:

*Case Insensitive Searching:

Max rows in search results:

Style Sheet Name:

Branding Application Package:

Branding Application Class:

Default rows in search results:

Tree Manager Options

Use Tree Update Reservation

Max Tree Inactivity Period,min:

Help Options

F1 Help URL:

Ctrl-F1 Help URL:

WSRP Display Mode

WSRP Display Mode:

Database Encryption Algorithm

Database Encryption Algorithm:

PeopleTools Options page

The system determines the total available number of temporary table instances for a base table according to your settings for total and online instances on this page.

Temp Table Instances (Total) (temporary table instances [total]) The difference between the total and online numbers is your EPM-managed tables. If you are not using PeopleSoft EPM, the total and online numbers should be the same.

Temp Table Instances (Online)(temporary table instances [online]) Enter the number of temporary table instances for Application Engine processes started online from the PeopleCode CallAppEngine function. In general, the number you enter should be relatively small (less than 10) so that extra instances do not affect performance.

Application Engine uses this value to identify a range of temporary tables devoted to programs called by the CallAppEngine function. A randomizing algorithm balances the load for the online process that is assigned to a temporary table devoted to running the program online.

Building Table Instances

The system builds temporary table instances at the same time it builds a base table for the record definition. When the system builds a table (as in Build, Current Object) and the record type is Temporary Table, it determines the total number of instances of the temporary table based on the settings made on PeopleTools Options page, and on the value of Instant Count, in Application Engine Program Properties, Temp Tables tab in Application Designer.

When Instance Count is lowered and temporary tables are rebuilt, temporary table instances are dropped and rebuilt. For instance, If the PeopleTools Option is set to 3 and Instance Count is 10 then there will be 14 tables in the System Catalog. If the Instance Count were lowered to 5 and tables are rebuilt ,14 tables would still remain in the System Catalog. The last 5 tables TAO10, TAO11, TAO12, TAO13, TAO14, need to be manually dropped to match what the Application Engine uses.

The system creates a maximum of 99 temporary table instances, even if the sum exceeds 99 for a particular temporary table.

The naming convention for temporary table instances is: BaseTableName_Number, where *Number* is a number between 1 and 99, as in PS_TEST_TMP23.

Note. You can take advantage of database-specific features such as table spaces and segmentation. For instance, you may want to use the Build process to generate a data definition language (DDL) script and then fine-tune the script before its execution, or you could place different sets of temporary tables on different table spaces according to instance number.

Managing Temporary Table Instances

This section provides an overview of temporary table instance numbers and discusses how to:

- Assign temporary tables to programs.
- Adjust meta-SQL.

Understanding Temporary Table Instance Numbers

You use the Temp Tables tab in the Program Properties dialog box to manage the number of different batch or dedicated temporary tables required for each program definition and the number of instances of each. You select all the necessary temporary table records to meet the needs of your program logic.

Note. You must set the instance count on the Temp Tables tab before building the tables in Application Designer.

Regardless of the instance counts value in the Application Engine program properties or on the PeopleTools Options page, make sure that you have the appropriate records assigned to the appropriate programs. You also need to ensure that the SQL inside your Application Engine program contains the correct usage of the %Table construct.

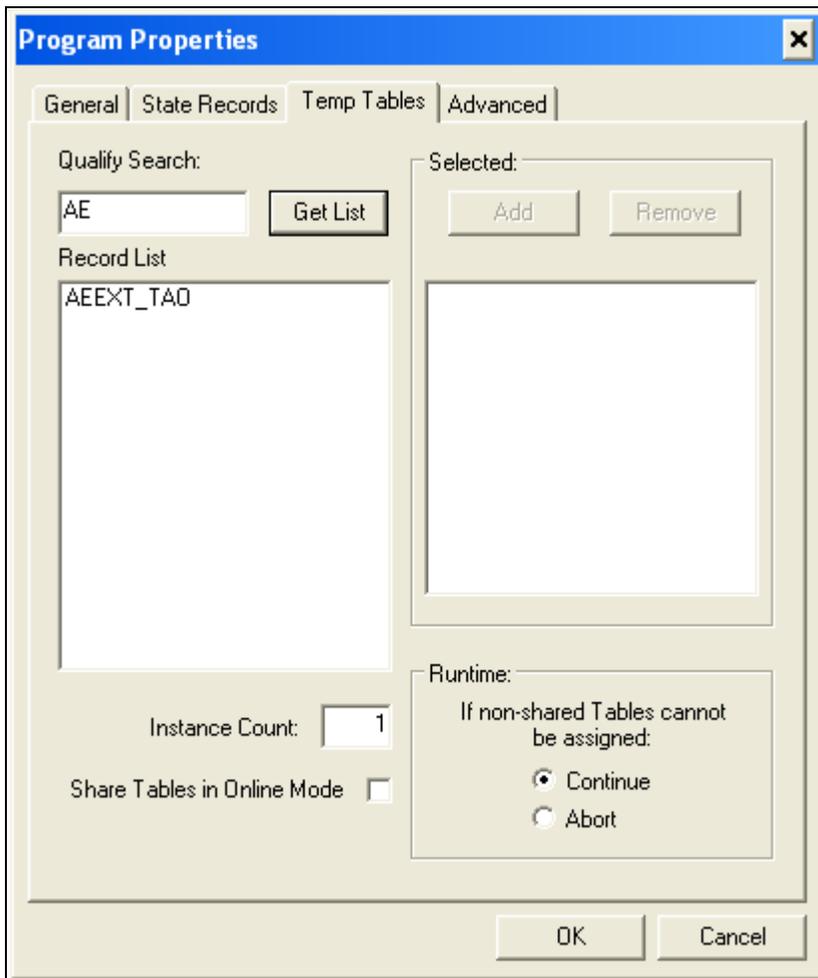
The number of temporary table instances built for a specific temporary table record during the SQL Build process is the value of the total temporary table instances from the PeopleTools Options page added to the sum of all the instance count values specified on the Temp Table tab for the Application Engine programs that use that temporary table.

For example, assume that you defined APPLTMPA as a temporary record type, the number of total temporary table instances is set to 10, and APPLTMPA appears in the Temp Tables tab in the Program Properties dialog box for two Application Engine programs. In one program, the instance count is set to 3, and in the other the instance count is set to 2. When you run the SQL Build process, PeopleTools builds a total of 15 temporary table instances for APPLTMPA.

The total and online instance counts should be equal unless your PeopleSoft application documentation provides specific instructions for setting these values differently. When the values are equal, the Temp Table Instances (Total) field controls the number of physical temporary table instances to be used by online programs that Application Designer creates for a temporary table record definition. If the value for the Temp Table Instances (Online) field is less than the value for the Temp Table Instances (Total) field, the difference between the two numbers provides a pool of tables for backward compatibility for developers who took advantage of the %Table (record_name, instance_number) approach for manually managing temporary table locking (such as in PeopleSoft EPM).

Assigning Temporary Tables to Programs

Open an Application Engine program in Application Designer. Select File, Definition Properties and then select the Temp Tables tab.



Program Properties dialog box:Temp Tables tab

In the Record List box, include all the necessary temporary table records for this program.

In the Instance Count field, specify the number of copies of temporary tables for a program. Any time you change the instance count, you should rebuild the temporary tables to ensure that the correct number of instances is created and available for your programs.

Share Tables in Online Mode has to be selected if the online Application Engine program needs to share the temporary table instances.

If an Application Engine program is currently sharing the temporary table instances , deselect the Share Tables in Online Mode to make the program use dedicated temporary tables. With Share Tables in Online Mode disabled, any temporary table instance can be accessed by only one online process at a time. In case no temporary table instances are available for an online Application Engine process, the process has to wait until one of the temporary table instance is released by other processes.

Note. The concept of dedicated temporary tables is isolated to the Application Engine program run. The locking, truncate/delete from, and unlocking actions are designed to occur within the bounds of an Application Engine program run. Therefore, the system does not keep a temporary table instance available after the Application Engine program run is over.

Runtime Allocation of Temporary Tables

Online processes have their own set of dedicated temporary tables, defined globally on the PeopleTools Options page. When you invoke a process online, PeopleTools randomly allocates a single temporary table instance number to a program for all its dedicated temporary table needs. While the program runs, no other program can use that instance number. Any other online process that happens to get the same instance value waits for the first program to finish so that the instance number is unlocked.

In contrast, batch processes are allocated temporary table instances on a record-by-record basis. The system begins with the lowest instance number available for each temporary table until all of the temporary table instances are in use. If no temporary tables are available and you selected Continue for the If non-shared Tables cannot be assigned group box, then the base table is used, with the process instance number as a key.

When a program ends normally or is cancelled with Process Monitor, the system automatically releases the assigned instances.

Condition	Online	Batch
Temporary tables are allocated using meta-SQL.	%Table(temp-tbl)	%Table(temp-tbl)
Temporary tables are allocated at runtime.	Psae.exe randomly assigns an instance number from the number range on your online temporary table setting on the PeopleTools Options page. Psae.exe uses that number for all tables for that program run.	Individually allocates an instance number based on availability on a record-by-record basis. Psae.exe begins with the lowest instance number available for each temporary table, until all of the instances are in use.
No temporary tables are free.	For a particular record, if the instance is currently in use and the program is set to <i>Continue</i> , then the psae.exe queues the program until the assigned instance number becomes free.	If the program is set to <i>Continue</i> , the system uses a shared base table. If the program is set to <i>Abort</i> , then the system terminates the program. <i>Never</i> queues for a table.
A temporary table is initially clear.	Yes, when program instance becomes available.	Yes, when assigned.
An instance number is locked.	The lock is on when the program is loading into memory.	The lock is on when the program is loading into memory. For restartable programs, the temporary tables remain locked across restarts until the program has completed successfully or until the temporary tables are manually released using Process Monitor or the Manage Abends page.

Condition	Online	Batch
An instance number is unlocked.	Temp tables unlocked on completion of program. In the event of a kill or a crash, the tables remain locked, and the tables must be freed using Process Monitor or the Manage Abends page.	If restart is disabled, the temporary tables are unassigned automatically in the event of a controlled abnormal termination. If you cancel a process using Process Monitor, PeopleTools frees the temporary tables automatically. When you use the Manage Abends page, you must click the Temp Tables button corresponding to the correct process instance, and then click the Release button on the Temporary Tables tab of the Application Engine program properties.

Note. After you manually release the temporary tables from their locked state, you lose any option to restart the program run.

Sharing Temporary Table Data

Dedicated temporary tables do not remain locked across process instances. If sequential Application Engine programs need to share data by way of temporary tables, a parent Application Engine program should call the programs that share data.

Adjusting Meta-SQL

A critical step in implementing parallel processing is to ensure that you have included appropriate meta-SQL within the code that your Application Engine program runs.

Referencing Temporary Tables

To reference a dedicated temporary table, you must use:

```
%Table(record)
```

You can reference any table with %Table, but only those records defined as temporary tables are replaced with a dedicated instance table by Application Engine. When you are developing programs that take advantage of %Table, choose temporary table indexes carefully. Depending on the use of the temporary table in your program and your data profile, the system indexes may be sufficient. On the other hand, a custom index may be needed instead, or perhaps no indexes are necessary at all. Consider these issues when designing your application. You want to define indexes and SQL that perform well in most situations, but individual programs or environments may require additional performance tuning during implementation.

Note. The default table name refers to PS_recname, where PS_recname1,2,... represents the dedicated temporary tables.

As Application Engine resolves any %Table, it checks an internal array to see if a temporary table instance has already been chosen for the current record. If so, then Application Engine substitutes the chosen table name. If not, as in when a record does not appear in the temp table list for the program, then Application Engine uses the base table instance (PS_recname) by default. Regardless of whether %Table is in PeopleCode SQL or in an Application Engine SQL Action, the program uses the same physical SQL table.

Populating a Temporary Table Process Instance with a Process Instance

All temporary tables should be keyed by process instance. If you use the Continue option when batch or dedicated tables cannot be assigned, Process Instance is required as a key field. The current process instance is automatically put into the state record, but when you insert rows into your temporary tables you must supply that process instance. Use %ProcessInstance or %Bind(PROCESS_INSTANCE) meta-SQL to return the numeric (unquoted) process instance.

The process instance value is always zero for programs initiated with the CallAppEngine function because the program called with CallAppEngine runs in process. That is, it runs within the same unit of work as the component with which it is associated.

If you are using dedicated tables and have elected to continue if dedicated tables cannot be assigned, then SQL references to dedicated temporary tables must include PROCESS_INSTANCE in the Where clause.

Clearing Temporary Tables

You do not need to delete data from a temporary table manually. The temporary tables are truncated automatically when they are assigned to your program. If a shared base table has been allocated because no dedicated instances were available, then Application Engine performs a delete by process instance instead of performing a truncate. In such a case, PROCESS_INSTANCE is required as a high-level key.

You can perform additional deletes of temporary table results during the run, but you must include your own SQL action that uses the %TruncateTable function. If the shared base table has been allocated because no dedicated instances were available, then %TruncateTable is replaced with a delete by process instance instead of a truncate.

Note. You should always use %TruncateTable to perform a mass delete on dedicated temporary tables, especially if the Continue option is in effect.

Even if you elected to terminate the program if a dedicated table cannot be allocated, you may still use %TruncateTable meta-SQL with dedicated temporary tables. %TruncateTable resolves to either a Truncate or a Delete by process instance, as needed.

The argument of %TruncateTable is a table name instead of a record name. As a result, you must code your SQL as shown in this example:

```
%TruncateTable(%Table(recname))
```

Note. You should avoid hard-coded table names inside %TruncateTable because they preclude the possibility of concurrent processing.

Making External Calls

When you call one Application Engine program from another, the assignment of dedicated tables for the called, or child, program occurs only if the calling, or parent, program is in a state where a commit can occur immediately.

PeopleTools enables you to commit immediately so that Application Engine can commit the update it performs to lock the temporary table instance. Otherwise, no other parallel process could perform any assignments. In general, you should issue a commit just before the Call Section action.

While making external program calls, note that:

- If the situation is suitable for a commit, then the temporary table assignment and the appropriate truncates occur.
- If the situation is not suitable for a commit and the called program is set to continue if dedicated tables cannot be allocated, then the base tables are used instead and a delete by process instance is performed.
- If the situation is not suitable for a commit and the called program is set to terminate if dedicated tables cannot be allocated, then the program run terminates.

This situation reflects an implementation flaw that you need to correct.

- The called Application Engine program is allowed to share temporary tables with the calling program.

Common temporary tables are the way you share data between the calling and called programs. Application Engine locks only instances of temporary tables that have not already been used during the current program run. Temporary tables that already have an assigned instance continue to use that instance.

External Calls in Batch Mode

For batch runs, list in the program properties of the root program all of the temporary tables that any called programs or sections use to ensure that the tables are locked sooner and as a single unit. This approach can improve performance, and it ensures that all the tables required by the program are ready before a run starts.

External Calls in Online Mode

If the online program run is designed to use any temporary tables at any point during the CallAppEngine unit of work, then the root program must have at least one temporary table specified in the Application Engine program properties. This statement is true even if the root program does not use temporary tables. Having at least one temporary table specified is required so that the system locks the instance number early so as to avoid an instance assignment failure after the process has already started processing.

All temporary tables used by a specific program, library, or external section must be specified in that program to ensure that the system issues truncates (deletes) for the tables being used.

If no temporary tables appear in the root program properties and if Application Engine encounters a %Table reference for a temporary table record, then an error appears.

Sample Implementation

The following scenario describes the runtime behavior of Application Engine and temporary tables.

Assume you have Program A and Program B and three temporary table definitions: PS_TMPA, PS_TMPB, and PS_TMPC. Values on the Temporary Tables tab in the Program Properties dialog box for each program are:

- Program A: PS_TMPA and PS_TMPB are specified as the dedicated temporary tables, and the instance count is 4.
- Program B: PS_TMPB and PS_TMPC are specified as the dedicated temporary tables, and the instance count is 3.

After you run the SQL Build process in Application Designer, the following inventory of temporary tables appears in the database.

For PS_TMPA:

- PS_TMPA1
- PS_TMPA2
- PS_TMPA3
- PS_TMPA4

For PS_TMPB:

- PS_TMPB1
- PS_TMPB2
- PS_TMPB3
- PS_TMPB4
- PS_TMPB5
- PS_TMPB6
- PS_TMPB7

For PS_TMPC:

- PS_TMPC1
- PS_TMPC2
- PS_TMPC3

Because the instance count for Program A is 4, the system builds four instances of PS_TMPA and PS_TMPB for Program A to use. Because the instance count for Program B is 3, the system builds an additional three instances of PS_TMPB and three instances of PS_TMPC for Program B to use.

Notice that because Program A and Program B are sharing PS_TMPB, seven instances were built. The system derives this total by adding the instance count value from all the programs that share a particular temporary table instance. In this case, the four from Program A and the three from Program B combine to require a total of seven instances of PS_TMPB to be built.

Given that this collection of temporary tables exists in your database, assume that you start Program A. At runtime, Application Engine examines the list of temporary tables dedicated to Program A and assigns the first available instances to Program A. Then, assuming that no other programs are running, Application Engine assigns PS_TMPA1 and PS_TMPB1 to Program A.

Suppose that shortly after you started Program A, another user starts Program B. Again, Application Engine examines the list of temporary tables dedicated to Program B and assigns the first available instances. In this scenario, Application Engine assigns PS_TMPB2 and PS_TMPC1 to Program B. Because Program A is already using PS_TMPB1, the system assigns PS_TMPB2 to Program B.

The system assigns records, such as TMPA, to programs. The base tables, such as PS_TMPA, are also built, by default, in addition to the dedicated temporary instances. If the Program Properties dialog box setting for the Temp Tables tab is set to Continue when no instances are available, then the system uses the base table instead of the dedicated instance.

Viewing Temporary Table Usage

This section discusses how to:

- View temporary table usage by record.
- View temporary table settings by program.
- View online instance usage.
- Resolve the temporary table usage warning message.

Viewing Temporary Table Usage by Record

Select PeopleTools, Application Engine, Review Temp Table Usage to access the Temp Table Usage by Record page.

Temp Table Usage by Record		Temp Table Settings by Program			
Temp Table Usage by Record					
Filter List by					
Record (Table) Name:	<input type="text"/>	Program Name:	<input type="text"/>	<input type="button" value="Refresh"/>	
Lock Details					
Record (Table) Name	Program Use Count	Total Instances	Locked Instances	Unused Instances	View Programs
AEEXT_TAO	1	5	0	5	View Programs
PSMSFTMPCOM	1	10	0	10	View Programs
PSMSFTMPIDS	1	10	0	10	View Programs
PSMSFTMPTBL	1	10	0	10	View Programs
PTPP_CPKP_TMP	1	1	0	1	View Programs
QE_AEEXT_TAO	1	5	0	5	View Programs
QE_AETEST_TAO	2	10	0	10	View Programs

Temp Table Usage by Record page

If you implemented temporary tables for parallel Application Engine program runs, use this page and the Temp Table Usage by Program page to find out how the system allocates temporary tables to your programs.

Parallel processing is designed to be a performance enhancing option. However, if the demand for temporary table instances consistently exceeds the current supply, performance suffers. Also, in other situations, your inventory of temporary table instances may far outnumber demand. Here, you may consider reducing the number of instances provided to conserve system resources.

This page shows you the following metrics for evaluating inventory and allocation of temporary tables.

Program Use Count	Shows the instance count of the listed program.
Total Instances	Shows the total number of existing instances of a temporary table.
Locked Instances	Shows the current number of instances that the system has locked for program runs.
Unused Instances	Shows the current number of instances that are available for use.

Viewing Temporary Table Settings by Program

Select PeopleTools, Application Engine, Review Temporary Table Usage, Temp Table Settings by Program to access the Temp Table Settings by Program page.

Settings Details					
Program Name	Total Instances	Batch Only	Abort Flag	Disable Restart	View Records
AETESTEXT	5	N	N	N	View Records
PSMSFGENSEQ	10	N	Y	Y	View Records
PTPP_CPPROJ	1	N	N	N	View Records
QE_AERESTART	5	N	N	N	View Records
QE_AETESTEXT	5	N	N	N	View Records
QE_AETESTPRG	5	N	N	Y	View Records

Temp Table Settings by Program page

If the Application Engine process was started in Process Monitor, you can select PeopleTools, Application Engine, Manage Abends to access the Manage Abends page and then the Process Monitor.

Viewing Online Instance Usage

Select PeopleTools, Application Engine, Review Online Instance Usage to access the Online Instance Usage page.

Locks Issued by Instance	
Temp Table Instance	Number of Locks Issued
0	0
1	0
2	0
3	0
4	0

Online Instance Usage page

Resolving the Temporary Table Usage Warning Message

If an Application Engine batch program is unable to get a dedicated temporary table because all instances are locked, but it can use the base table, the system issues a warning. However, if the program is set to terminate when a dedicated instance is not available, then the program terminates even if the base table can be used.

You could see the warning message in two ways:

- A warning message appears in the standard output of the process.

When running from the command prompt, the message appears in that window. When the program is running on a server through PeopleSoft Process Scheduler, the output is sent to the standard status file, which you can access using Process Monitor.

- A warning message appears in the AET trace file if a dedicated temporary table instance cannot be locked because none is available.

This message appears in the trace file regardless of the trace settings you selected.

If you see the warning about base temporary table usage, then an insufficient number of temporary table instances are defined or some locked instances must be released.

When a restartable process terminates abnormally, the temporary tables stay locked to enable a smooth restart. However, if you do not want to restart the process, then you must release the locked temporary tables. When you cancel the process using Process Monitor, the release of locked temporary tables occurs automatically. If the process was not launched through PeopleSoft Process Scheduler, Process Monitor does not track the process and you must use the Manage Abends page to release temporary tables used by processes invoked outside of PeopleSoft Process Scheduler.

Index

