IBM MQSeries Workflow for OS/390

Programming Guide

Version 3 Release 2

SC33-7031-03

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SC33-7031-03

Note!
Before using this information and the product it supports, be sure to read the general information under "Notices" on page xiii.

Third Edition (February 2000)

This edition applies to Version 3, Release 2, Modification Level 1 of IBM MQSeries Workflow for OS/390 (product number 5565-A96) and to all subsequent releases and modifications until otherwise indicated in new editions.

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About this book

This book describes how to use the IBM MQSeries Workflow for OS/390 Runtime (Client) Application Programming Interface (MQSeries Workflow API) and also to invoke API requests by passing messages in Extensible Markup Language (XML) to an MQSeries queue from an application. The first part of the book describes the concepts underlying the API while the rest of the book provides a reference for the API action calls. The book also describes the MQSeries Workflow predefined data structures.

Note: The licensed books that were declassified in OS/390 Version 2 Release 4 appear on the OS/390 Online Library Collection, SK2T-6700. The remaining licensed books for OS/390 Version 2 appear on the OS/390 Licensed Product library, LK2T-2499, in unencrypted form.

Who should read this book

This book is intended for programmers who design and implement programs using an MQSeries Workflow API and who may participate in designing an MQSeries Workflow workflow model. It assumes that readers are experienced OS/390 programmers and that they understand the process modeling concepts.

How to get additional information

Visit the MQSeries Workflow home page at

`http://www.software.ibm.com/ts/mqseries/workflow`

For a list of additional publications, refer to "MQSeries Workflow publications" on page 585.

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How this book is organized

"Notices" on page xiii describes some notices and trademarks.

"Chapter 1. MQSeries Workflow programming concepts" on page 1 provides an overview of how to design applications to work with the MQSeries Workflow workflow manager.

"Chapter 2. Language interfaces" on page 125 discusses the API from the perspective of the language used: C, C++, Java, or COBOL.

"Chapter 3. Interfacing with the Program Execution Server" on page 167 describes the interface with the Program Execution Server, including the use of program mappings to bring Workflow API containers into a format acceptable by legacy applications and how to use exits.

"Chapter 4. API classes and objects" on page 227 provides an overview of the classes supported by the API.

"Chapter 5. API action and activity implementation calls" on page 287 describes the API calls that enable applications to manipulate worklists and work items, to work with process instances and container data, and to log on to and log off from an MQSeries Workflow server.

"Chapter 6. Examples" on page 525 provides some examples that show how to use the API.

The back of the book includes a glossary that defines terms as they are used in this book, a bibliography, and an index.

How to read the syntax diagrams

Throughout this book, syntax is described the following way; all spaces and other characters are significant:

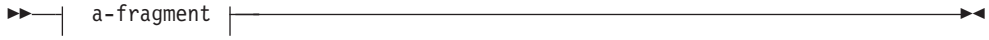
- Read the syntax diagrams from left to right, from top to bottom, following the main path of the line.

  The ►►— symbol indicates the beginning of a statement.

  The —► symbol indicates that the statement syntax is continued on the next line.

  The ►— symbol indicates that a statement is continued from the previous line.

  The —►◄ symbol indicates the end of a statement.
- Diagrams can be broken into fragments. A fragment is indicated by vertical bars with the name of the fragment between the bars. The fragment itself follows the same syntactical rules as the main diagram.

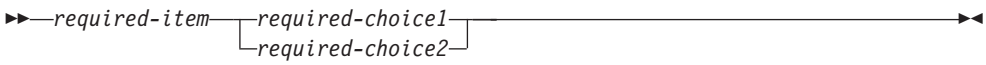


- Required items appear on the horizontal line, the main path.

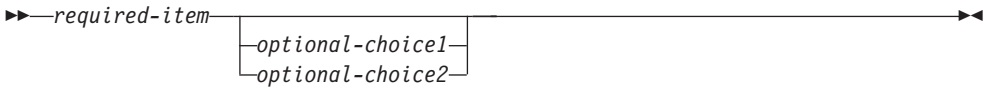
- Optional items appear below (or above) the main path.

- If you can choose from one or more items, they appear vertically, in a stack.

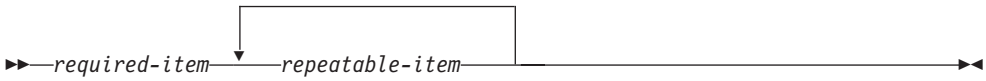
  If you must choose one of the items, one item of the stack appears on the main path.



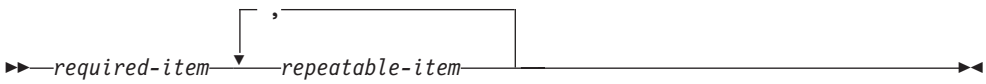
If choosing one of the items is optional, the entire stack appears below the main path.



- An arrow returning to the left, above the main path, indicates an item that can be repeated.



If the repeat arrow contains a comma, you must separate repeated items with a comma.



- Keywords appear in uppercase, for example, NAME. They must be spelled exactly as shown. Variables appear in lowercase italic letters, for example, *string*. They represent user-supplied values.

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Summary of changes

This edition reflects changes related to the following APARs:

- PQ34 776
- PQ34 802
- PQ34 803
- PQ34 805
- PQ34 806

In particular, a new PES exit has been introduced to provide event notification in conjunction with program invocations. For details, see "Program execution server exits" on page 202.

Chapter 1. MQSeries Workflow programming concepts

This chapter provides you with a general introduction to the programming concepts of MQSeries Workflow.

Understanding Workflow programming

This section introduces the concept of workflow modeling as it relates to the design of application programs for use with IBM MQSeries Workflow.

MQSeries Workflow provides a way to model a process and assign applications to activities in the resulting workflow model. This enables the workflow manager to automate the control of activities and the flow of data.

Work can be routed to the person who performs the activity instance. An application program required to perform an activity instance can be designed to start when a user starts an activity instance.

The role of the programmer in modeling a process

As workflow models are defined, the applications and data structures needed to support program activities are identified. Programmers can create new applications, integrate existing applications, or reengineer existing applications to support these program activities.

To reengineer existing applications with the workflow model, programmers must determine if the applications used by the enterprise can be functionally decomposed. The control and flow logic are separated from the application, the start and exit conditions are moved into the workflow model, and the program is divided into modules to be invoked by the workflow manager at the appropriate points. The resulting modules are applications that are assigned to perform the program activities defined in the workflow model.

Most applications include many diverse functions, and many can support several different activities in different stages of a process. Output produced by one function of a program can be used as input by another function of the same program. Therefore, the same application can be used to support many different program activities in a workflow model.

Your enterprise might also use Enterprise Resource Planning (ERP) or packaged applications like word-processing or spreadsheet applications.

Decomposition of such applications may not be possible. However, a programmer could write shell procedures that query the contents of containers, pass data from an input container to the program when the activity instance is started, and direct data into an output container when it finishes.

With MQSeries Workflow you will be able to use mappings so you can support any legacy application with this tool. There may be old applications whose interfaces you can't change because other applications or programs have been configured to work with these long time ago: if you changed one configuration of an interface, you would have to change them all. This mapper enables you to use all legacy applications with your Workflow applications via the mapping tool.

Return codes, provided by the assigned program, can then be used to evaluate exit and transition conditions.

Programming interfaces

MQSeries Workflow provides application program interface (API) and Extensible Markup Language (XML) message interface support, as well as a set of predefined data structure members, to assist programmers who develop applications for use with workflow models. In addition, several programming samples are provided.

In a programming-language-based programming model, the client application makes an API call in order to execute a request. In a message-based programming model, the request and information needed to execute the request are contained in a message that is interchanged through a message queuing system between the client application and a server.

The MQSeries Workflow predefined data structure members provide information about the current process, activity, or block, and are associated with the operating characteristics of a process instance or activity instance.

API interfaces in the following languages are described in this book:
- C
- C++
- COBOL
- Java
- MQSeries Workflow XML message interface

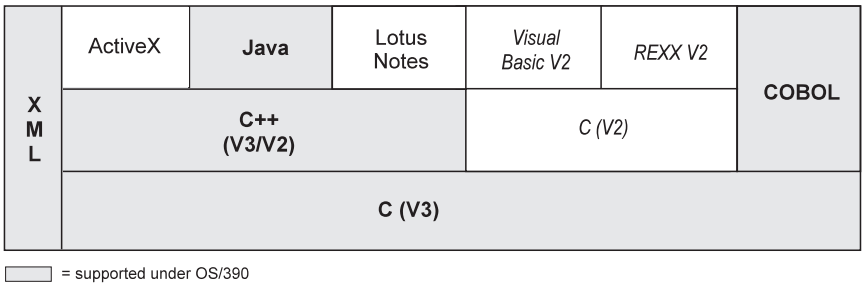


Figure 1. MQSeries Workflow Client API hierarchy

The basic interfaces for requesting Runtime services from MQSeries Workflow are a C API and an XML message interface. Access can be gained to the C functions from all languages that support C calls - see “Compiling and linking” on page 127 for more information. A C++ language API is provided on top of the C API. The C++ API is a small layer of inline methods, that is, delivered as source code. The Java API is implemented on top of the C++ layer, and the COBOL API on top of the C layer.

MQSeries Workflow uses the XML 1.0 standard (see *W3C Recommendation: Extensible Markup Language (XML) 1.0*) as the document description language.

The MQSeries Workflow API provides API calls:
- To execute process models, that is, to work with process instances and container data and to manipulate worklists and work items
- To monitor the progress of execution
- To issue process administrator functions

- To receive information sent by an MQSeries Workflow server
- To process container data associated with an activity implementation

Prerequisites for using a programming language API

MQSeries Workflow application development assumes that the appropriate environment is established. This means that:

- MQSeries Workflow for OS/390 must be installed on the machine where you are developing your applications.
- A compiler of one of the supported languages must be installed and configured.
- Buildtime must be installed on the machine where you are developing your applications.

Refer to "Chapter 2. Language interfaces" on page 125 for more information.

Overview of the Runtime API

There are various tasks which you typically want to address by writing an MQSeries Workflow application program:

- You can write a client application to:
  - Manage process instances
  - Handle worklists and/or work items
  - Administer process instances or work items
  - Monitor the progress of execution
- You can write a program that implements an activity in your workflow process.

These programs typically use only a subset of the MQSeries Workflow API. For example, an activity implementation typically only accesses its containers, that is, uses only the so-called Container API, which is a subset of the full API especially configured for container-only processing. The MQSeries Workflow API, that is, its header files and library structures or its import packages take this fact into account. IMS programs must use the Container API.

In order to ask for Runtime services, communication must be established between the client application and an MQSeries Workflow execution server.

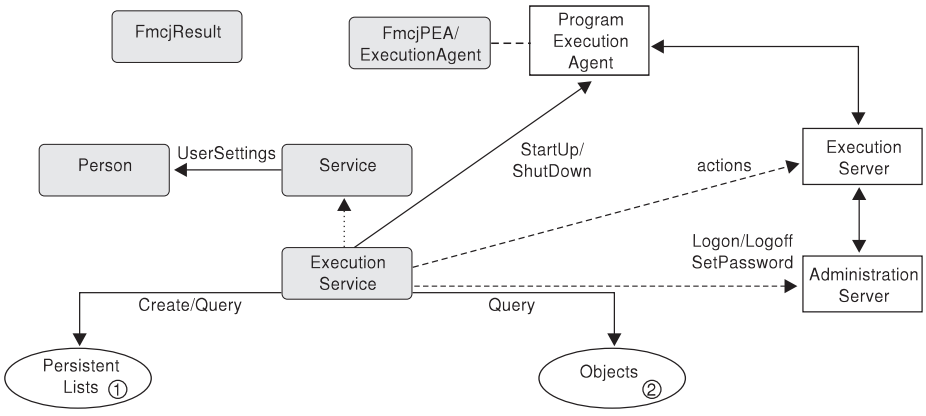


Figure 2. Setting up client/server communication. Legend: ⇢ Inheritance (C++); ⟶ provides for access; ⟶ sends messages to

As a first step, an ExecutionService object must be obtained (constructed/allocated/located). An ExecutionService object represents a session

between a user and an MQSeries Workflow execution server. It essentially provides the basic API calls to set up a communication path to the specified MQSeries Workflow execution server and to establish the user session (Logon() or Passthrough()), and finish it (Logoff()). To log on, not only the execution server but also the administration server must be up and running so that authentication can be done. This is, however, transparent to you.

When the session to an execution server has been established, you can:
- Query objects for which you are authorized: process templates, process instances, items (work items, activity instance notifications, process instance notifications), or lists containing such objects.
- Create persistent lists, that is, persistent views on objects contained in the MQSeries Workflow database.
- Query information about the logged-on user or change that user's password.

In C, C++, and COBOL, all API calls update a so-called result object. Detailed information about an erroneous request can be obtained from there. See "Handling errors" on page 8 for more information.

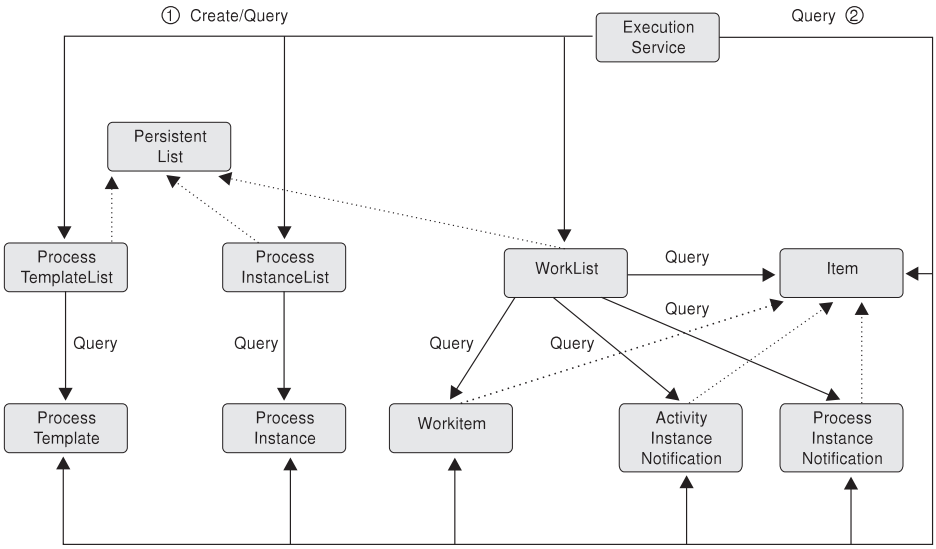


Figure 3. Querying objects. Legend: --➤ Inheritance (C++); ⟶ provides for access

When the session to an execution server has been established, you can create or query persistent lists (process template lists, process instance lists, worklists) or query other objects for which you are authorized. At runtime, you can retrieve the currently valid version of a process template only; you cannot see any future or past versions.

A persistent list represents a set of objects the user is authorized for. It is a view of those objects. All objects which are accessible through the list have the same characteristics. These characteristics are specified by a filter. For example, depending on the filter specified, a worklist can contain a set of work items only. No activity instance notifications or process instance notifications are accessible through that list. The worklist content, the work items, can be queried and their attributes can be accessed. As soon as a work item has been read from the execution server, further actions can be called, for example, starting a work item.

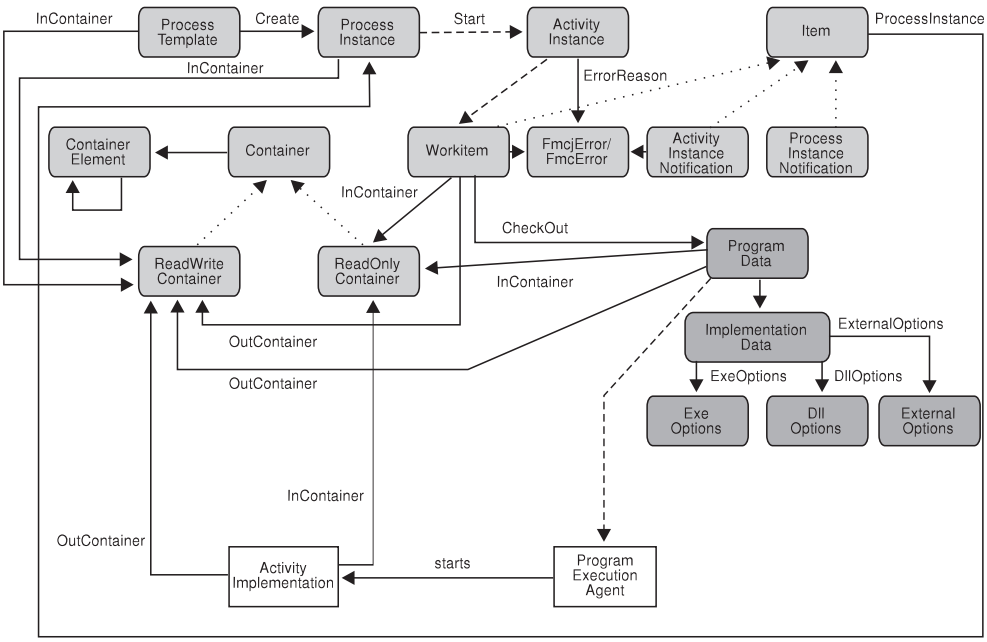


Figure 4. Dealing with process instances and (work) items. Legend: --➔ Inheritance (C++); ⟶ provides for access; — ⟶ data is passed to or results in

When a valid version of a process template has been retrieved, a process instance can be created and started. Starting a process instance can require input data. You can use the Container API calls for reading and writing values. See "Handling containers" on page 30 for more information.

Starting a process instance triggers the scheduling of activity instances and, as a result of that, the creation of a set of work items and possibly activity instance notifications or process instance notifications when they are not worked on in time. A work item implemented by a program can then be executed either by MQSeries Workflow-specific means or by user-specific means.

When executed by user-specific means, the work item is to be checked out. Checking out provides for all information needed to execute the underlying program, the program data and its description of the implementing options and the input container data.

When executed by MQSeries Workflow-specific means, that program data is automatically sent to the program execution server which starts the appropriate activity implementation. The activity implementation can then access its input and output containers via an appropriate request to the program execution server. The same container accessor API calls are applicable whether called from a client application program or from an activity implementation program.

When a work item and thus the associated activity instance has not been executed successfully, the FmcjError or FmcError object provides for analyzing the cause of the state InError.

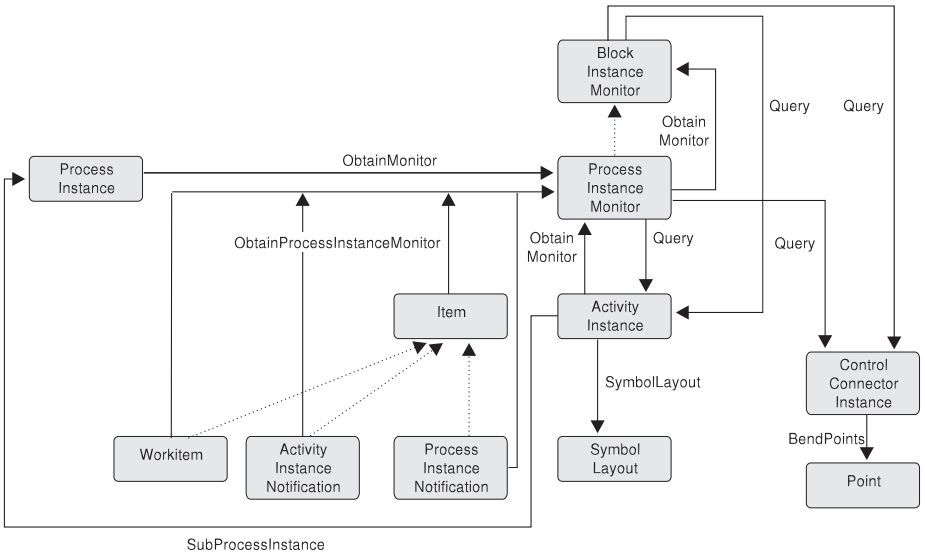


Figure 5. Monitoring a process instance. Legend: --► Inheritance (C++); ⟶ provides for access

When a process instance or item, that is, a work item, an activity instance notification, or a process instance notification, has been retrieved, you can obtain the associated process instance monitor. The process instance monitor then allows for analyzing the states of activity instances and control connector instances. The path taken through the process instance can thus be determined. In case you want to present this information graphically, the activity instance symbol layout and the control connector instance positions and bend points offer support.

Once a process instance monitor has been obtained, you can iterate into the process model by obtaining block instance monitors for activities of type Block or process instance monitors for activities of type Process, that is, for subprocess instances. See “Monitoring a process instance” on page 65 for more information.

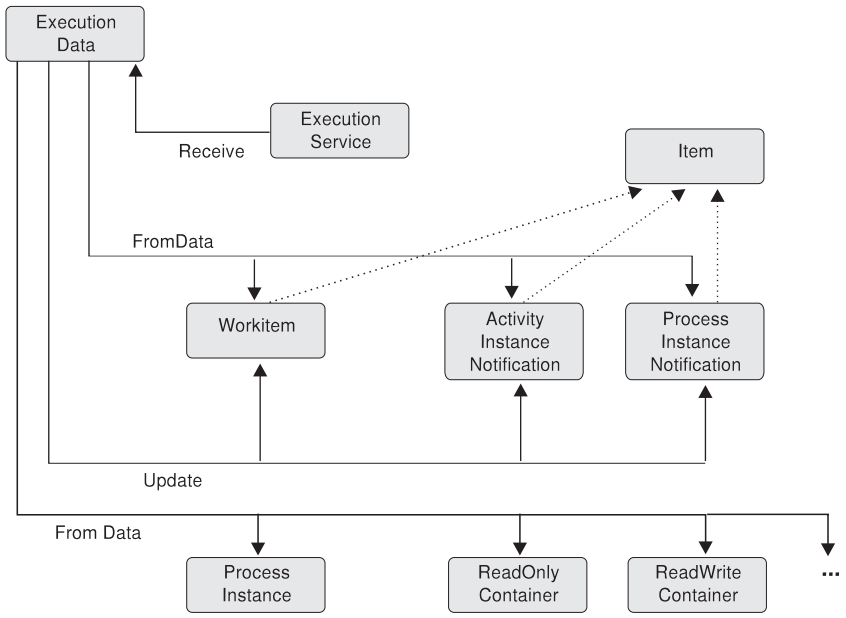


Figure 6. Handling data sent by an MQSeries Workflow server. Legend: -➤ Inheritance (C++); ⟶ provides for access

When the process setting specifies a *push refresh policy*, then the MQSeries Workflow execution server pushes changes on work items or notifications to a present client. In this case, or when the application issues an asynchronous request, the client application should set up a means in order to receive data or responses sent by the server. Once received, the appropriate object can be updated, created, or deleted depending on the information sent. See "Client/server communication and data access models" on page 16 for more information.

Building an MQSeries Workflow application

Overview

There are essentially two different tasks which you can address by using the MQSeries Workflow API:

- You can write your own client application . For example, you may want to:
  - control the MQSeries Workflow functionality provided to your user.
  - present the MQSeries Workflow functionality in a way that your user is accustomed to.
  - run selected MQSeries Workflow tasks in batch mode.
- You can write a program that implements an activity in your workflow process model.

These two kinds of programs usually contain specific parts which are described in the sections "Coding an MQSeries Workflow client application" and "Coding an MQSeries Workflow activity implementation". in the discussions of the respective language interfaces in "Chapter 2. Language interfaces" on page 125.

The concepts underlying the MQSeries Workflow API are common to all programs using the MQSeries Workflow API. They are summarized here and discussed in more detail in the following chapters.

Concepts of the programming language API

All persistent objects such as work items and process instances are accessed through transient objects which represent their state at the time they were queried from a server. In C and COBOL, a so-called *handle* represents a pointer to such a transient object.

In order to request an action on an object, a session must have been established with an appropriate MQSeries Workflow server. The action itself can then be executed synchronously. Some actions can also be executed asynchronously.

Only objects for which you are authorized are returned from the server to the client.

Separate API calls (termed functions, methods, or subprograms, depending on the language) in the C, C++, COBOL, or Java languages are available for each action on an object or for accessing each property of an object. This approach allows API call parameters to be checked by the compiler and best represents the object-action paradigm supported by MQSeries Workflow.

In C, C++, and COBOL, detailed error information is provided by a so-called *result object*. This object is available in addition to the return code set by action API calls. See "The result object" on page 12 for detailed information on the result object.

Objects are managed by the application programmer but object memory is owned by the MQSeries Workflow API. The application programmer determines the lifetime of transient objects by using allocate, or query, and deallocate mechanisms. The MQSeries Workflow API hides the internal structure of transient objects.

Concepts of the XML message interface

All persistent objects are accessed by their unique name, that is, the actual name may need to be padded with the printable version of the object's identifier in order to achieve uniqueness.

In order to request an action, a session need not be established as in the programming language API. You must, however, be authorized for the action itself.

All actions are executed asynchronously. Correlation data is part of the message so that the application can correlate the request sent to MQSeries Workflow and the execution server response.

Handling errors

All action, activity implementation, or program execution management API calls messages show whether or not the call has been successfully executed by passing back a *return code*. Java throws an appropriate FmcException when the method has not been executed successfully. The XML message interface provides the return code in the response message. The return code is one of a set of predefined codes (see "List of return codes" on page 9). The exact return codes or exceptions for each of those API calls are listed with the description of each call. You should design your programs to handle all return codes or exceptions that can arise.

In addition to the return code, a so-called *result object* can be accessed in C, C++, and COBOL, which describes the result of the call in more detail - see "The result object" on page 12.

Basic and accessor API calls either do not return a value or return the value queried. Since they are querying transient objects and are able to return default

values, an error does normally not occur. It can, however, happen during application development that a wrong handle or a buffer too small to hold a character value is specified. To look for such erroneous situations, the *result object* can be queried (besides checking the trace).

List of return codes

The following list shows the numeric values of the return codes that are issued by the MQSeries Workflow API; it is strongly advised to use the symbolic names instead of the integer values. For COBOL, the return code identifiers have a maximum length of 30 characters. Additional words in the return codes are separated by hyphens and not by underscores (as is common for C). In order to avoid misunderstandings, the C version of the return codes is used in this book, especially in descriptions of the API calls ("Chapter 5. API action and activity implementation calls" on page 287).

Table 1. List of return codes

Numeric value	Symbolic value (C/C++)	Symbolic value (COBOL)
0	FMC_OK	FMC-OK
1	FMC_ERROR	FMC-ERROR
10	FMC_ERROR_USERID_UNKNOWN	FMC-ERROR-USERID-UNKNOWN
11	FMC_ERROR_ALREADY_LOGGED_ON	FMC-ERROR-ALR-LOGGED-ON
12	FMC_ERROR_PASSWORD	FMC-ERROR-PASSWORD
13	FMC_ERROR_COMMUNICATION	FMC-ERROR-COMMUNICATION
14	FMC_ERROR_TIMEOUT	FMC-ERROR-TIMEOUT
100	FMC_ERROR_INTERNAL	FMC-ERROR-INTERNAL
101	FMC_ERROR_SERVER	FMC-ERROR-SERVER
102	FMC_ERROR_UNKNOWN	FMC-ERROR-UNKNOWN
103	FMC_ERROR_MESSAGE_FORMAT	FMC-ERROR-MESSAGE-FORMAT
104	FMC_ERROR_MESSAGE_DATA	FMC-ERROR-MESSAGE-DATA
105	FMC_ERROR_RESOURCE	FMC-ERROR-RESOURCE
106	FMC_ERROR_NOT_LOGGED_ON	FMC-ERROR-NOT-LOGGED-ON
107	FMC_ERROR_NEW_OWNER_NOT_FOUND	FMC-ERROR-NEW-OWNER-NOT-FOUND
108	FMC_ERROR_NO_OLD_OWNER	FMC-ERROR-NO-OLD-OWNER
109	FMC_ERROR_OLD_OWNER_ABSENT	FMC-ERROR-OLD-OWNER-ABSENT
110	FMC_ERROR_NEW_OWNER_ABSENT	FMC-ERROR-NEW-OWNER-ABSENT
111	FMC_ERROR_ALREADY_STARTED	FMC-ERROR-ALR-STRTD
112	FMC_ERROR_MEMBER_NOT_FOUND	FMC-ERROR-MEMBER-NOT-FOUND
113	FMC_ERROR_MEMBER_NOT_SET	FMC-ERROR-MEMBER-NOT-SET
114	FMC_ERROR_WRONG_TYPE	FMC-ERROR-WRONG-TYPE
115	FMC_ERROR_MEMBER_CANNOT_BE_SET	FMC-ERROR-MEMBER-CANNOT-BE-SET
116	FMC_ERROR_MEMBER_INVALID	FMC-ERROR-MEMBER-INVAL
117	FMC_ERROR_FORMAT	FMC-ERROR-FORMAT
118	FMC_ERROR_DOES_NOT_EXIST	FMC-ERROR-DOES-NOT-EXIST
119	FMC_ERROR_NOT_AUTHORIZED	FMC-ERROR-NOT-AUTH
120	FMC_ERROR_WRONG_STATE	FMC-ERROR-WRONG-STATE
121	FMC_ERROR_NOT_UNIQUE	FMC-ERROR-NOT-UNIQUE
122	FMC_ERROR_EMPTY	FMC-ERROR-EMPTY
123	FMC_ERROR_NO_MANUAL_EXIT	FMC-ERROR-NO-MANUAL-EXIT
124	FMC_ERROR_PROFILE	FMC-ERROR-PROFILE
125	FMC_ERROR_INVALID_FILTER	FMC-ERROR-INVAL-FILTER
126	FMC_ERROR_PROGRAM_EXECUTION	FMC-ERROR-PROGRAM-EXECUTION
127	FMC_ERROR_PROTOCOL	FMC-ERROR-PROTOCOL
128	FMC_ERROR_TOOL_FUNCTION	FMC-ERROR-TOOL-FUNCTION
129	FMC_ERROR_INVALID_TOOL	FMC-ERROR-INVAL-TOOL
130	FMC_ERROR_INVALID_HANDLE	FMC-ERROR-INVAL-HANDLE

Table 1. List of return codes (continued)

Numeric value	Symbolic value (C/C++)	Symbolic value (COBOL)
131	FMC_ERROR_NOT_EMPTY	FMC-ERROR-NOT-EMPTY
132	FMC_ERROR_INVALID_USER	FMC-ERROR-INVAL-USER
133	FMC_ERROR_OWNER_ALREADY_ASSIGNED	FMC-ERROR-OWNER-ALR-ASSIGNED
134	FMC_ERROR_INVALID_NAME	FMC-ERROR-INVAL-NAME
135	FMC_ERROR_INVALID_PROGRAMID	FMC-ERROR-INVAL-PROGRAMID
136	FMC_ERROR_SIZE_EXCEEDED	FMC-ERROR-SIZE-EXCEEDED
406	FMC_ERROR_WRONG_ACT_IMPL_KIND	FMC-ERROR-WRONG-ACT-IMPL-KIND
500	FMC_ERROR_NON_LOCAL_USER	FMC-ERROR-NON-LOCAL-USER
501	FMC_ERROR_WRONG_KIND	FMC-ERROR-WRONG-KIND
502	FMC_ERROR_INVALID_ACTIVITY	FMC-ERROR-INVAL-ACT
503	FMC_ERROR_CHECKOUT_NOT_POSSIBLE	FMC-ERROR-CHKOUT-NOT-POSSIBLE
504	FMC_BACK_LEVEL_VERSION	FMC-BACK-LEVEL-VERSION
505	FMC_ERROR_NEWER_VERSION	FMC-ERROR-NEWER-VERSION
506	FMC_ERROR_INVALID_CORRELATION_ID	FMC-ERROR-INVAL-CORRELATION-ID
507	FMC_ERROR_NOT_ALLOWED	FMC-ERROR-NOT-ALLOWED
508	FMC_ERROR_BACK_LEVEL_OBJECT	FMC-ERROR-BACK-LEVEL-OBJ
509	FMC_ERROR_INVALID_CONTAINER	FMC-ERROR-INVAL-CNTR
510	FMC_ERROR_UNEXPECTED_CONTAINER	FMC-ERROR-UNEXPECTED-CNTR
511	FMC_ERROR_NO_PROGRAM_FOR_PLATFORM	FMC-ERROR-NO-PROG-FOR-PLATF
800	FMC_ERROR_BUFFER	FMC-ERROR-BUFFER
801	FMC_ERROR_INVALID_SESSION	FMC-ERROR-INVAL-SESSION
802	FMC_ERROR_INVALID_TIME	FMC-ERROR-INVAL-TIME
804	FMC_ERROR_NO_MORE_DATA	FMC-ERROR-NO-MORE-DATA
805	FMC_ERROR_INVALID_OID	FMC-ERROR-INVAL-OID
807	FMC_ERROR_INVALID_THRESHOLD	FMC-ERROR-INVAL-THRESHOLD
808	FMC_ERROR_INVALID_SORT	FMC-ERROR-INVAL-SORT
809	FMC_ERROR_OBJECT_IN_USE	FMC-ERROR-OBJ-IN-USE
810	FMC_ERROR_INVALID_DESCRIPTION	FMC-ERROR-INVAL-DESCRIPTION
811	FMC_ERROR_INVALID_INVOCATION_TYPE	FMC-ERROR-INVAL-INV-TYPE
812	FMC_ERROR_OWNER_NOT_FOUND	FMC-ERROR-OWNER-NOT-FOUND
813	FMC_ERROR_INVALID_LIST_TYPE	FMC-ERROR-INVAL-LIST-TYPE
814	FMC_ERROR_INVALID_RESULT_HANDLE	FMC-ERROR-INVAL-RESULT-HANDLE
815	FMC_ERROR_MESSAGE_CATALOG	FMC-ERROR-MESSAGE-CATALOG
816	FMC_ERROR_INVALID_SPECIFICATION	FMC-ERROR-INVAL-SPECIFICATION
817	FMC_ERROR_QRY_RESULT_TOO_LARGE	FMC-ERROR-QRY-RESULT-TOO-LARGE
818	FMC_ERROR_NO_VERSION_2_FILTER	FMC-ERROR-NO-VERSION-2-FILTER
819	FMC_ERROR_INVALID_USER_CONTEXT	FMC-ERROR-INVAL-USER-CONTEXT
900	FMC_ERROR_NO_SYS_ADMIN	FMC-ERROR-NO-SYS-ADMIN
901	FMC_ERROR_INVALID_SESSION_MODE	FMC-ERROR-INVAL-SESSION-MODE
902	FMC_ERROR_PROGRAM_UNDEFINED	FMC-ERROR-PROGRAM-UNDEFINED
903	FMC_ERROR_PEA_NOT_RUNNING	FMC-ERROR-PEA-NOT-RUNNING
904	FMC_ERROR_PEA_NOT_LOCAL	FMC-ERROR-PEA-NOT-LOCAL
905	FMC_ERROR_INVALID_ABSENCE_SPEC	FMC-ERROR-INVAL-ABSENCE-SPEC
1000	FMC_ERROR_NOT_SUPPORTED	FMC-ERROR-NOT-SUPPORTED
1012	FMC_ERROR_PROGRAM_NOT_DEFINED	FMC-ERROR-PROGRAM-NOT-DEFINED
1014	FMC_ERROR_PEA_NOT_REACHABLE	FMC-ERROR-PEA-NOT-REACHABLE
1015	FMC_ERROR_INVALID_PEA_FROM_CTNR	FMC-ERROR-INVALID-PEA-FRM-CTNR
1016	FMC_ERROR_INVALID_PEA_FROM_MODEL	FMC-ERROR-INVAL-PEA-FRM-MODEL
1017	FMC_ERROR_INVALID_SYSTEM_FROM_CTNR	FMC-ERROR-INVAL-SYSTEM-FRM-CTNR
1018	FMC_ERROR_INVALID_SYSTEM_FROM_MODEL	FMC-ERROR-INVAL-SYSTEM-FRM-MODEL
1019	FMC_ERROR_SUB_PROC_TERMINATED_BY_ERROR	FMC-ERROR-SB-PRC-TERM-BY-ERROR
1020	FMC_ERROR_NO_PEA_FOUND_FOR_AUTO_START	FMC-ERROR-NO-PEA-FND-FR-AUT-ST

Table 1. List of return codes (continued)

Numeric value	Symbolic value (C/C++)	Symbolic value (COBOL)
1021	FMC_ERROR_NO_CTNR_ACCESS	FMC-ERROR-NO-CTNR-ACCESS
1022	FMC_ERROR_INVALID_CONFIG_ID	FMC-ERROR-INVAL-CONFIG_ID
1023	FMC_ERROR_MIG_OF_RUNNING_PROG	FMC-ERROR-MIG-OF-RUNNING-PROG
1024	FMC_ERROR_MIG_OF_CHCKDOUT_SUSP	FMC-ERROR-MIG-OF-CHCKDOUT-SUSP
1025	FMC_ERROR_MIGRATION_NO_SUBPROC	FMC-ERROR-MIGRATION-NO-SUBPROC
1100	FMC_ERROR_XML_DOCUMENT_INVALID	FMC-ERROR-XML-DOCUMENT-INVAL
1101	FMC_ERROR_XML_NO_MQSWF_DOCUMENT	FMC-ERROR-XML-NO-MQSWF-DOC
1102	FMC_ERROR_XML_MESSAGE_NOT_SUPPORTED	FMC-ERROR-XML-MSG-NOT-SUPP
1103	FMC_ERROR_XML_WRONG_DATA_STRUCTURE	FMC-ERROR-XML-WRONG-DATA-STR
1104	FMC_ERROR_XML_DATA_MEMBER_NOT_FOUND	FMC-ERROR-XML-D-M-NOT-FOUND
1105	FMC_ERROR_XML_DATA_MEMBER_WRONG_TYPE	FMC-ERROR-XML-D-M-WRONG-TYPE
2000	FMC_ERROR_INVALID_QUEUE_SCOPE	FMC-ERROR-INVAL-QUEUE-SCOPE

Object and memory management

Workflow process models, their instances, and resulting work items are all objects persistently stored in an MQSeries Workflow database. This means that they exist independently from an application program.

When persistent objects are queried by an application program, they are represented by *transient objects* which carry the states of the persistent objects at the time of the query. When multiple queries are issued, there can be multiple transient objects representing the same persistent object, even representing different states of that object.

The lifetime of transient objects and their memory is *fully managed* by you, because you know best when those objects are no longer needed, that is, when objects are to be deallocated (C, COBOL) or destructed (C++). Transient objects are, however, no longer available when your application program ends.

Some transient objects are *explicitly allocated* by you. These support objects which do not reflect persistent ones. Examples are FmcjStringVector when you specify a set of persons to stand in for (C or COBOL) or ExecutionService object, which allows services to be requested from an execution server.

Transient objects which reflect persistent objects are *implicitly allocated* by you when you create or retrieve persistent objects, for example, by querying.

Although the lifetime of transient objects is fully managed by you, their actual internal object structure is encapsulated by the MQSeries Workflow API. The MQSeries Workflow API provides a handle (C, COBOL) to you so that you can issue requests against the object. In the C++ API, that handle is the only data member of your class. Therefore, you are independent of internal changes. It further allows MQSeries Workflow to ″lazy read″ (read only on demand) a collection of objects passed from the server and thus increases performance.

The MQSeries Workflow API follows the *programming by contract* concept. This means that any handle passed to it which is not 0 (NULL) is assumed to be a valid handle which can be used to access an object. This is especially important to be considered for queries. Any nonzero vector handle is assumed to point to an

already existing vector of objects and is used in order to add newly qualifying objects. In other words, **you should initialize any new handle to 0**.

As all resource memory is finally owned by the application process itself, you can access all objects from different threads within that process. MQSeries Workflow does not hinder you from using threads; it is coded reentrantly. On the other hand, MQSeries Workflow does not explicitly support threads. If you want to access the same transient object from within different threads, you have to synchronize the access to that object. Objects are **not** thread-safe.

The result object

In general, a result object states the result of the last MQSeries Workflow API request (in the affected thread). It especially allows for analyzing an erroneous situation in more detail and contains the following information:

- The return code.
- The origin of the result, that is, the file that caused the result to be written, and the line and function where the error or the completion of the request occurred.
- Parameters (up to five) which describe the objects involved.

The result can be retrieved as a formatted message text with all parameters added to the text. The current locale is considered when building that message text so that the message is provided in your selected language.

All results of API calls are written into the result object associated with the thread the request executes in. It is sufficient to access the result object just once per thread using the FmcjResultObjectOfCurrentThread() function or the FmcjResult::ObjectOfCurrentThread() method. (As threads are not supported in MQSeries Workflow for OS/390, ″OfCurrentThread″ is mentioned here for compatibility reasons with versions that do support threads.) The result object is automatically updated with each request.

A result object is automatically allocated by MQSeries Workflow when the first MQSeries Workflow API call is issued in that thread. It can be accessed at any time and as often as needed.

C example:

```
#include <stdio.h>
#include <fmcjcrun.h>
int main()
{
  FmcjResultHandle        result      = 0;
  FmcjStringVectorHandle  parms       = 0;
  char                    buffer[2000]= "";

  result= FmcjResultObjectOfCurrentThread();
  printf( "Accessed result object of current thread\n" );

  printf( "Return code: %i\n", FmcjResultRc(result) );
  printf( "Text       : %s\n", FmcjResultMessageText(result,buffer,2000) );
  printf( "Origin     : %s\n", FmcjResultOrigin(result,buffer,2000) );
  parms= FmcjResultParameters(result);
  while ( 0 != FmcjStringVectorNextResultParmElement( parms, buffer, 2000 ) )
    printf( "Parameter  : %s\n", buffer );

  return 0;
}
```

Figure 7. Accessing a result object in C

Note: The NextResultParmElement() function is used on the string vector so that the result object is not changed while reading the parameters.

C++ example:

```
#include <iomanip.h>
#include <bool.h>
#include <vector.h>
#include <fmcjstr.hxx>
#include <fmcjprun.hxx>
int main()
{
  vector<string> parms;
  FmcjResult *pResult = FmcjResult::ObjectOfCurrentThread();

  cout << "Accessed result object of current thread" << endl;
  cout << "Return code: " << pResult->Rc()           << endl;
  cout << "Text       : " << pResult->MessageText() ;
  cout << "Origin     : " << pResult->Origin()       << endl;
  pResult->Parameters(parms);
  cout << "Parameter  : ";
           for (int i=0; i<parms.size(); i++)
           {
             cout << parms[i] << " ";
           }
  cout << endl;

  delete pResult;                      // cleanup object from heap
  return 0;
}
```

Figure 8. Accessing a result object in C++

Note: The transient C++ representation of your result object is destructed like any other object. Each retrieval of the result object constructs a separate representation.

COBOL examples:

```
IDENTIFICATION DIVISION.
PROGRAM-ID. "RESOBJ".

DATA DIVISION.

  WORKING-STORAGE SECTION.

  COPY fmcvars.

  01 buffer PIC X(2000) VALUE SPACES.

PROCEDURE DIVISION.

     PERFORM FmcjResultObjOfCurrentThread.
     DISPLAY "Accessed result object of current thread".

     SET hdlResult TO FmcjResultHandleReturnValue.
     PERFORM FmcjResultRc.
     DISPLAY "Return code: " intReturnValue.
     MOVE 2000 TO bufferlength.
     CALL "SETADDR" USING buffer messageBuffer.
     PERFORM FmcjResultMessageText.
     DISPLAY "Text       : " buffer.
     CALL "SETADDR" USING buffer originBuffer.
     PERFORM FmcjResultOrigin.
     DISPLAY "Origin     : " buffer.
     PERFORM FmcjResultParms.
     SET hdlVector TO FmcjStrVHandleReturnValue.

     CALL "SETADDR" USING buffer elementBuffer.
     PERFORM FmcjStrVNextResultParmElement.

     PERFORM UNTIL pointerReturnValue = NULL
        DISPLAY "Parameter  : " buffer
        PERFORM FmcjStrVNextResultParmElement
     END-PERFORM.

     STOP RUN.

     COPY fmcperf.
```

Figure 9. Accessing a result object in COBOL (via PERFORM)

```
IDENTIFICATION DIVISION.
PROGRAM-ID. "RESOBJ".

DATA DIVISION.

  WORKING-STORAGE SECTION.

  COPY fmcvars.

  01 buffer PIC X(2000) VALUE SPACES.

PROCEDURE DIVISION.


     CALL "FmcjResultObjectOfCurrentThread"
        RETURNING FmcjResultHandleReturnValue.
     DISPLAY "Accessed result object of current thread".

     SET hdlResult TO FmcjResultHandleReturnValue.
     CALL "FmcjResultRc"
        USING BY VALUE hdlResult
        RETURNING intReturnValue.
     DISPLAY "Return code: " intReturnValue.
     MOVE 2000 TO bufferlength.
     CALL "SETADDR" USING buffer messageBuffer.
     CALL "FmcjResultMessageText"
        USING BY VALUE hdlResult
                       messageBuffer
                       bufferLength
        RETURNING pointerReturnValue.
     DISPLAY "Text       : " buffer.
     CALL "SETADDR" USING buffer originBuffer.
     CALL "FmcjResultOrigin"
         USING BY VALUE hdlResult
                        originBuffer
                        bufferLength
         RETURNING pointerReturnValue.
     DISPLAY "Origin     : " buffer.
     CALL "FmcjResultParameters"
         USING BY VALUE hdlResult
         RETURNING FmcjStrVHandleReturnValue.
     SET hdlVector TO FmcjStrVHandleReturnValue.

     CALL "SETADDR" USING buffer elementBuffer.
     CALL "FmcjStringVectorNextResultParmElement"
         USING BY VALUE hdlVector
                        elementBuffer
                        bufferLength
         RETURNING pointerReturnValue.

     PERFORM UNTIL pointerReturnValue = NULL
        DISPLAY "Parameter  : " buffer
        CALL "FmcjStringVectorNextResultParmElement"
            USING BY VALUE hdlVector
                           elementBuffer
                           bufferLength
            RETURNING pointerReturnValue
     END-PERFORM.

     STOP RUN.
```

Figure 10. Accessing a result object in COBOL (via CALL)

Note: The SETADDR routine is shown in "Example of the use of strings" on page 150 .

Client/server communication and data access models

When you request actions from an MQSeries Workflow server or when you want to observe the result of actions, you can:

- Use a synchronous protocol to ask for an action and to view changes of the object which you used to call the action.
- Use a synchronous protocol to pull for data created or changed.
- Receive unsolicited information on created or changed objects pushed by the server.

For example, when you ask a process instance object to be started:

- As an immediate result, the state of the process instance is updated.
- You can query work items in order to view (pull for) new objects created.
- You can automatically receive new work items sent (pushed) to you.

Synchronous client/server communication

Applying a synchronous protocol means that you issue a request to an MQSeries Workflow server and then wait until you receive a response. All action API calls operate this way; your application (thread) is blocked until the response arrives or until your timeout set on the execution service object exceeds.

Note: The synchronous mode of communication is not supported for the XML message interface.

Asynchronous client/server communication

Applying an asynchronous protocol means that you issue a request to an MQSeries Workflow server but you do not wait until you receive a response. The ExecuteProcessInstanceAsync() API call operates this way; your application (thread) is not blocked and you can receive the response at a later time.

When you issue an action asynchronously, you do, however, receive an acknowledgement telling whether MQSeries Workflow accepted the request. You can also receive a correlation identification which you can use in order to receive a specific response. You can specify a user context in order to correlate a response received.

For example, when you ask a process instance to be executed asynchronously:

- As an immediate result, you are informed whether the request is accepted.
- When you specify a buffer to hold a correlation ID, you get an ID which you can use in the Receive() call to wait for that specific response.
- When you specify a user context, that context is returned to you as part of the response. You can use it for user-specific correlation.

Note: The asynchronous mode of communication is only supported in C, C++, and COBOL. All message-based requests are executed asynchronously.

The push data access model

Receiving unsolicited information pushed by an MQSeries Workflow server means that you set up communication in a way that you are automatically informed about new or changed objects.

Note: The push data access model is not supported in Java or the XML message interface.

In order to obtain information pushed by an MQSeries Workflow server:

1. The server must be asked to send data. This means that:
   - The settings of the applicable process instance must specify *REFRESH_POLICY PUSH*. This setting is inherited from the domain level, through the system group to the system and down to the process template. Each specification can be overwritten on a lower level.
   - The users must be logged on with a *Present* or *PresentHere* session mode, that is, they are enabled to receive information.
2. The application must use API calls in order to receive data pushed.

Provided that these prerequisites are fulfilled, the MQSeries Workflow execution server pushes changes on work items or notifications to the owner of the item:

1. On creation of the item.
2. On deletion of the item.
3. Whenever a primary property of the item changes - see "Accessor API calls" on page 85 for a definition of primary properties.

The caller of the action will, however, not receive such information because, as a result of the action, the transient object has already been updated with relevant data.

Changes to disabled work items are not pushed. Only the deletion of such work items is pushed.

Examples:

When a process instance is suspended and when its refresh policy is push, the MQSeries Workflow execution server notifies all owners of non-disabled items which are currently logged on as present.

When the description of a process instance is changed and when the refresh policy is push, the MQSeries Workflow execution server notifies all owners of process instance notifications which are currently logged on as present.

When a work item is transferred to user N by the owner of the work item and when the refresh policy of the associated process instance is push, the MQSeries Workflow execution server notifies user N when he/she is currently logged on as present. The owner of the work item as the requester of the action gets no additional notification.

Note: Filtering and sorting is left to the application. No indication about affected worklists is pushed to the client.

Receiving information

In C, C++, and COBOL, the ExecutionService object provides for a means to receive information (execution data) pushed by an MQSeries Workflow execution server at any time desired. The Receive() call blocks the calling application until information is received or until the specified timeout value has been reached. That is why an application, if possible, typically starts a separate thread for receiving data, in order to prevent blocking the entire application.

A timeout value of -1 specifies an indefinite wait time interval. Note that in this case you must ensure that you stop receiving data before your application ends.

There is a TerminateReceive() API call which can be used to send a terminate indication to the receiving part of the application in order to provide notification that receiving data may end.

Notes:

1. A Receive() call survives a Logoff() call, which ends your session with an execution server. The execution server, however, stops pushing information when logoff has been executed. If you did not send a TerminateReceive() to the receiving application thread, you have to end that thread because of other knowledge. TerminateReceive() can only be called as long as a session exists.
2. If information is not received and therefore stays in the client input queue, the MQSeries expiration mechanism applies in order to eliminate such "dead" messages. The expiration time of client messages can be configured for MQSeries Workflow.

When receiving data, a correlation identification can be specified to indicate which information is to be read. If it is not specified or points to FMCJ_NO_CORRELID, then any data arriving is received; the correlation identification is set as the result of a successful receive.

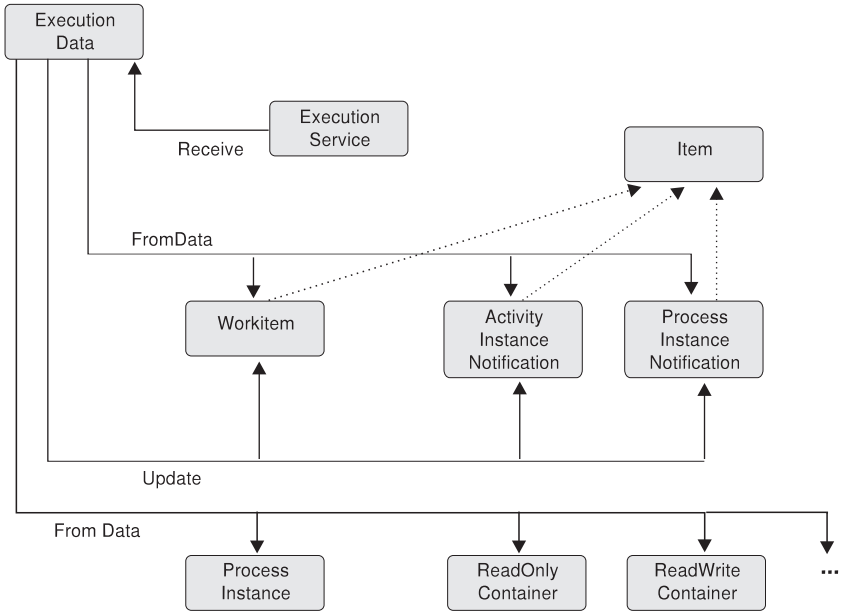


Figure 11. Handling data sent by an MQSeries Workflow server. Legend: --► Inheritance (C++); ⟶ provides for access

Once execution data has been received, its type can be determined and the appropriate action can be called. For example, when a work item creation is indicated, a conversion from the execution data to a work item can be requested. When a work item change is indicated, the persistent object ID of the work item can be requested so that the appropriate work item can be updated.

When the response to an ExecuteProcessInstanceAsync() request is received, the process instance created and executed can be analyzed. For example, its state can be used to determine whether the process instance executed successfully. Its output container can then be read. If an error occurs, the error description can be examined.

An MQSeries Workflow session

In order to communicate with an MQSeries Workflow server, a session must have been established between the user and that server. The server is either identified explicitly (system at system group) or taken from the user's profile. If the information is not found in the user's profile, the configuration profile is read.

Note: Authentication is not required in order to use the XML message interface, that is, a session need not be established.

The session is established by logging on. From then on services can be requested from the server; the service object which represents the session between the user logging on and the server, is set up accordingly.

Logon requires that the administration server be up and running on the selected system, because the administration server manages sessions and checks the authentication of the user. It additionally ensures that any severe errors are written to the error log.

Any objects which are retrieved or created belong to the session where they have been queried or created. They carry the session identification so that further actions on those objects are executed in the same session with the authorization of the logged-on user.

A single application program or multiple application programs can allocate multiple service objects and log on with different users or the same user in parallel. Sessions are kept separate by the service objects. A single service object thus represents a single session. A second request to log on via a service object will be rejected if it comes from a different user. Otherwise, it is accepted but not repeated; the logon request has already been executed successfully.

A session can run in *default* mode or in *present* mode. When you are operating in the present session mode, activity instances which are started automatically can be scheduled on your behalf and you can receive information pushed by an MQSeries Workflow server. There can only be a single present session per user.

The service object provides for a timeout value to be set. This is the time the application waits for the answer from a server. The application is thus blocked during this time at a maximum. The timeout is specified in milliseconds. A value of -1 denotes an indefinite timeout value. The timeout value can be changed at any time.

Note: MQSeries Workflow uses the communication mechanisms of IBM MQSeries. If your application sets up its own signal handler, then you should refer to the *MQSeries Application Programming Guide*, especially the chapter *UNIX signal handling*, for restrictions imposed by MQSeries.

Querying data

There are essentially three means of querying data from an MQSeries Workflow server:

- A query via a service object, which returns all authorized objects. The number of objects returned to the client can be restricted by a filter and a threshold.
- A query using a persistent list definition, which returns all objects qualifying through the list definition.

- A specific request, like the request for user settings or a refresh request for a specific object.

Note: Querying data is not supported by the XML message interface.

Persistent lists

A persistent list represents a set of objects of the same type. Moreover, all objects which are accessible through the list have the same characteristics. A list can be for public usage, that is, it is visible by all users, or for private usage, that is, it has an owner and is only visible by that owner.

The characteristics of the objects contained in the list are given by so-called *filter criteria*. The filter criteria specified and the authorization of the user issuing the query determine the contents of the list. This means that the contents itself is not stored persistently but determined when a query request is issued. This in particular means that a public list can deliver different results depending on the user who applies the query.

The number of objects transferred from the server to the client as the result of the query can be restricted by specifying a *threshold*. The threshold is used after *sort criteria* have been applied.

A list can be a process template list, a process instance list, or a worklist.

Using filters, sort criteria, and thresholds

A filter is a character string specifying criteria which must follow the rules stated by the filter syntax diagrams. Refer to the appropriate API calls for the exact syntax. Some sample criteria are shown here:

```
"NAME = 'MyProcessInstance'"
"NAME LIKE 'My*Ins?ance'"
"LAST_MODIFICATION_TIME > '1998-2-19 11:38:0'"
"STATE IN (READY,RUNNING)"
```

A sort criterion is a character string that must follow the rules stated by the sort criteria syntax diagrams. Refer to the appropriate API calls for the exact syntax. Some sample criteria are shown here:

```
"NAME ASC"
"NAME ASC, LAST_MODIFICATION_TIME DESC"
```

Objects are sorted on the server, that is, the code page of the server determines the sort sequence.

A threshold specifies the maximum number of objects to be returned to the client. That threshold is applied after the objects have been sorted.

Handling collections

The result of a query for a set of objects is a so-called vector of objects in C, C++, or COBOL, or an array of objects in Java.

A vector is provided by the caller and filled by the MQSeries Workflow API. The ownership of the vector elements, the objects, stays with the vector. They are automatically deleted when the vector is deleted.

Any objects returned are appended to the supplied vector. If you want to read the current objects only, you have to clear the vector before you call the query method. This means that you should erase all elements of the vector in the C++ API. This means that you should set the vector handle to 0 in C and COBOL.[1] If the vector handle is not initialized to 0, it *must* point to a vector of objects of the appropriate kind so that newly queried objects can be appended. In other words, any nonzero handle is used by C or COBOL in order to access a vector assumed to already exist.

In C or COBOL, the result of the query is the vector handle initialized to the set of objects, if a 0 handle was passed, otherwise the existing vector extended by the new objects. Special vector accessor functions are provided to access the objects (see below). When a vector element is read, it becomes an object of its own and thus has to be deleted when no longer used. Any operations on that object refer to the object only and do not have any impacts on the vector element from which the object was copied. For example, a Refresh() changes the object only but not its original copy within the vector. This means that a further iteration through the vector finds any elements unchanged.

In C++, the result of the query is an instance of vector<class T>. Access to the objects is gained via appropriate vector methods; refer to the STL documentation. When a vector element is read, a (const or non-const) reference to the object is returned. This means that a change of the object does actually change the vector element. A further iteration through the vector finds the elements changed.

An array is provided and filled by the MQSeries Workflow API. The ownership of the array elements, the objects, stays with the array.

C and COBOL vector accessor functions

Vector accessor functions are described below. This is because all these functions are similar in appearance and have similar requirements, even for different objects. They are all handled locally by the API, that is, they do not communicate with the server. Neither a connection to a server nor specific authorizations are required to execute.

Return codes

The C or COBOL functions or the result object can return the following codes. The number in parentheses shows their integer value:

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is expected, but 0 is passed.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is invalid; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_NO_MORE_DATA(804)
The vector contains no or no more element.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

1. Declare a new vector handle or deallocate an existing vector object before reuse.

Vector accessor functions allow for the operations listed below. **'Xxx'** denotes a particular scope; for example, FmcjXxxVectorFirstElement() can stand for FmcjProcessInstanceVectorFirstElement().

FmcjXxxVectorDeallocate()

Allows the application to deallocate the storage reserved for the specified transient vector object. All elements contained are also deallocated.

The handle is set to 0 so that it can no longer be used.

C

```
APIRET FMC_APIENTRY FmcjXxxVectorDeallocate(
                        FmcjXxxVectorHandle * hdlVector)
```

COBOL

```
        FmcjXxxVectorDeallocate.

           CALL    "FmcjXxxVectorDeallocate"
                          USING
                          BY REFERENCE
                             hdlVector
                          RETURNING
                             intReturnValue.
```

Parameters

hdlVector Input/Output. The address of the handle to the vector to be deallocated.

FmcjXxxVectorFirstElement()

Returns the first element of the vector. That element becomes an object on its own and has to be deallocated if no longer used. The vector is positioned to the next element.

If the vector is empty or if an error occurred, 0 (zero) is returned.

C

```
FmcjXxxHandle FMC_APIENTRY FmcjXxxVectorFirstElement(
              FmcjXxxVectorHandle hdlVector )
```

COBOL

```
        FmcjXxxVectorFirstElement.

           CALL    "FmcjXxxVectorFirstElement"
                          USING
                          BY VALUE
                             hdlVector
                          RETURNING
                             FmcjXxxHandleReturnValue.
```

Parameters

hdlVector Input. The handle of the vector to be queried.

Return type
FmcjXxxHandle
The handle of the first element of the vector or 0.

FmcjXxxVectorNextElement()

Returns the vector element at the current vector position; the initial vector position is the first element. That element becomes an object on its own and has to be deallocated if no longer used. The vector is positioned to the next element.

If the vector is empty, if there are no more elements in the vector, or if an error occurred, 0 (zero) is returned.

C

```
FmcjXxxHandle FMC_APIENTRY FmcjXxxVectorNextElement(
              FmcjXxxVectorHandle hdlVector )
```

COBOL

```
        FmcjXxxVectorNextElement.

           CALL    "FmcjXxxVectorNextElement"
                          USING
                          BY VALUE
                             hdlVector
                          RETURNING
                             FmcjXxxHandleReturnValue.
```

Parameters
hdlVector Input. The handle of the vector to be queried.

Return type
FmcjXxxHandle
The handle of the vector element at the current position or 0.

FmcjXxxVectorSize()

Returns the number of elements in the vector.

C

```
unsigned long FMC_APIENTRY FmcjXxxVectorSize(
              FmcjXxxVectorHandle hdlVector )
```

COBOL

```
        FmcjXxxVectorSize.

           CALL    "FmcjXxxVectorSize"
                          USING
                          BY VALUE
                             hdlVector
                          RETURNING
                             ulongReturnValue.
```

Parameters

hdlVector Input. The handle of the vector to be queried.

Return type
unsigned long

The number of elements in the vector.

C examples

In the following, some C examples on how to read a vector are shown; note that you can start with a first element call or a next element call.

```
#include <stdio.h>
#include <fmcjcrun.h>
int main()
{
   APIRET                          rc;
   FmcjExecutionServiceHandle      service      = 0;
   FmcjProcessInstanceVectorHandle hdlVector    = 0;
   FmcjProcessInstanceHandle       hdlInstance  = 0;
   unsigned long                   i            = 0;
   unsigned long                   numElements  = 0;
   char                            tInfo[FMC_PROCESS_INSTANCE_NAME_LENGTH]="";
  FmcjGlobalConnect();

  FmcjExecutionServiceAllocate(&service);
  rc = FmcjExecutionServiceLogon( service,
                                  "ADMIN", "PASSWORD",
                                  Fmc_SM_Default, Fmc_SA_Reset
                                 );
  if ( rc != FMC_OK )
    return rc;
  printf("Logged on\n");
  rc= FmcjExecutionServiceQueryProcessInstances(
                               service,
                               FmcjNoFilter,
                               FmcjNoSortCriteria,
                               FmcjNoThreshold,
                               &hdlVector  );
  if ( rc != FMC_OK )
     return rc;
  printf("Queried process instances\n");
  hdlInstance= FmcjProcessInstanceVectorFirstElement(hdlVector);
  numElements= FmcjProcessInstanceVectorSize(hdlVector);

  printf("Instances in the vector:\n");
  for( i=0; i< numElements; i++ )
  {
  printf("- name: %s\n",
           FmcjProcessInstanceName(hdlInstance,tInfo,
                                   FMC_PROCESS_INSTANCE_NAME_LENGTH));
  FmcjProcessInstanceDeallocate(&hdlInstance);
  hdlInstance= FmcjProcessInstanceVectorNextElement(hdlVector) ;
  }

  FmcjProcessInstanceVectorDeallocate(&hdlVecor);
  FmcjExecutionServiceLogoff(service);
  printf("Logged off\n");
  FmcjExecutionServiceDeallocate(&service);

   FmcjGlobalDisconnect();
   return FMC_OK;
}
```

Figure 12. Reading a vector in C (using First/NextElement() calls)

```
#include <stdio.h>
#include <fmcjcrun.h>
int main()
{
  APIRET                          rc;
  FmcjExecutionServiceHandle      service     = 0;
  FmcjProcessInstanceVectorHandle hdlVector   = 0;
  FmcjProcessInstanceHandle       hdlInstance = 0;
  char                            tInfo[FMC_PROCESS_INSTANCE_NAME_LENGTH]="";

  FmcjGlobalConnect();

  FmcjExecutionServiceAllocate(&service);
  rc = FmcjExecutionServiceLogon( service,
                                  "ADMIN", "PASSWORD",
                                  Fmc_SM_Default, Fmc_SA_Reset
                                );
  if ( rc != FMC_OK )
    return rc;
  printf("Logged on\n");

  rc= FmcjExecutionServiceQueryProcessInstances(
                               service,
                               FmcjNoFilter,
                               FmcjNoSortCriteria,
                               FmcjNoThreshold,
                               &hdlVector  );
  if ( rc != FMC_OK )
    return rc;
  printf("Queried process instances\n");

  printf("Instances in the vector:\n");
  while (0 != (hdlInstance=FmcjProcessInstanceVectorNextElement(hdlVector)))
  {
    printf("- name: %s\n",
           FmcjProcessInstanceName(hdlInstance,tInfo,
                                   FMC_PROCESS_INSTANCE_NAME_LENGTH));
    FmcjProcessInstanceDeallocate(&hdlInstance) );
  }
   FmcjProcessInstanceVectorDeallocate(&hdlVector) );

  FmcjExecutionServiceLogoff(service);
  printf("Logged off\n");
  FmcjExecutionServiceDeallocate(&service);

  FmcjGlobalDisconnect();
  return FMC_OK;
}
```

Figure 13. Reading a vector in C (using NextElement() call only)

COBOL examples

In the following, some COBOL examples on how to read a vector are shown; note that you can start with a FirstElement or NextElement call.

```
IDENTIFICATION DIVISION.
PROGRAM-ID. "VECTOR".

DATA DIVISION.

  WORKING-STORAGE SECTION.

  COPY fmcvars.
  COPY fmcconst.
  COPY fmcrcs.

  01 localUserID   PIC X(30) VALUE z"ADMIN".
  01 localPassword PIC X(30) VALUE z"PASSWORD".
  01 numElements   PIC 9(9) BINARY.
  01 i             PIC 9(9) BINARY.
  01 buffer        PIC X(64) VALUE SPACES.

  LINKAGE SECTION.

  01 retCode            PIC S9(9) BINARY.

PROCEDURE DIVISION USING retCode.

     PERFORM FmcjGlobalConnect.
     PERFORM FmcjESAllocate.

     CALL "SETADDR" USING localUserId userId.
     CALL "SETADDR" USING localPassword passwordValue.
     MOVE Fmc-SM-Default TO sessionMode.
     MOVE Fmc-SA-Reset TO absenceIndicator.
     PERFORM FmcjESLogon.

     MOVE intReturnValue TO retCode
     IF retCode NOT = FMC-OK THEN GOBACK.
     DISPLAY "Logged on".

     CALL "SETADDR" USING FmcjNoFilter filter.
     CALL "SETADDR" USING FmcjNoSortCriteria sortCriteria.
     MOVE FmcjNoThreshold TO threshold.
     PERFORM FmcjESQueryProcInsts.

     SET hdlVector TO instances.
     MOVE intReturnValue TO retCode
     IF retCode NOT = FMC-OK THEN GOBACK.
     DISPLAY "Queried Process Instances".

     PERFORM FmcjPIVFirstElement.
     SET hdlInstance TO FmcjPIHandleReturnValue.
     PERFORM FmcjPIVSize.
     MOVE ulongReturnValue TO numElements.

     DISPLAY "Instances in the vector:".
     MOVE FMC-PROC-INST-NAME-LENGTH TO bufferLength.
     CALL "SETADDR" USING buffer instanceNameBuffer.
     PERFORM VARYING i FROM 0 BY 1 UNTIL i >= numElements
        PERFORM FmcjPIName
        DISPLAY "- name: " buffer
        PERFORM FmcjPIDeallocate
        PERFORM FmcjPIVNextElement
        SET hdlInstance TO FmcjPIHandleReturnValue
     END-PERFORM
```

Figure 14. Reading a vector in COBOL (using First/NextElement calls) (Part 1 of 2)

```
PERFORM FmcjPIVDeallocate.
PERFORM FmcjESLogoff.
DISPLAY "Logged off".
PERFORM FmcjESDeallocate.
PERFORM FmcjGlobalDisconnect.
MOVE FMC-OK TO retCode.
GOBACK.

COPY fmcperf.
```

Figure 14. Reading a vector in COBOL (using First/NextElement calls) (Part 2 of 2)

```
IDENTIFICATION DIVISION.
PROGRAM-ID. "VECTOR".

DATA DIVISION.

  WORKING-STORAGE SECTION.

  COPY fmcvars.
  COPY fmcconst.
  COPY fmcrcs.

  01 localUserID   PIC X(30) VALUE z"ADMIN".
  01 localPassword PIC X(30) VALUE z"PASSWORD".
  01 buffer        PIC X(64) VALUE SPACES.

  LINKAGE SECTION.

  01 retCode            PIC S9(9) BINARY.

PROCEDURE DIVISION USING retCode.

     PERFORM FmcjGlobalConnect.
     PERFORM FmcjESAllocate.

     CALL "SETADDR" USING localUserId userId.
     CALL "SETADDR" USING localPassword passwordValue.
     MOVE Fmc-SM-Default TO sessionMode.
     MOVE Fmc-SA-Reset TO absenceIndicator.
     PERFORM FmcjESLogon.

     MOVE intReturnValue TO retCode
     IF retCode NOT = FMC-OK THEN GOBACK.
     DISPLAY "Logged on".

     CALL "SETADDR" USING FmcjNoFilter filter.
     CALL "SETADDR" USING FmcjNoSortCriteria sortCriteria.
     MOVE FmcjNoThreshold TO threshold.
     PERFORM FmcjESQueryProcInsts.

     SET hdlVector TO instances.
     MOVE intReturnValue TO retCode
     IF retCode NOT = FMC-OK THEN GOBACK.
     DISPLAY "Queried Process Instances".

     DISPLAY "Instances in the vector:".
     MOVE FMC-PROC-INST-NAME-LENGTH TO bufferLength.
     CALL "SETADDR" USING buffer instanceNameBuffer.

     PERFORM FmcjPIVNextElement.

     PERFORM UNTIL FmcjPIHandleReturnValue = NULL
        SET hdlInstance TO FmcjPIHandleReturnValue
        PERFORM FmcjPIName
        DISPLAY "- name: " buffer
        PERFORM FmcjPIDeallocate
        PERFORM FmcjPIVNextElement
     END-PERFORM
```

Figure 15. Reading a vector in COBOL (using NextElement calls only) (Part 1 of 2)

```
PERFORM FmcjPIVDeallocate.
PERFORM FmcjESLogoff.
DISPLAY "Logged off".
PERFORM FmcjESDeallocate.
PERFORM FmcjGlobalDisconnect.
MOVE FMC-OK TO retCode.
GOBACK.

COPY fmcperf.
```

Figure 15. Reading a vector in COBOL (using NextElement calls only) (Part 2 of 2)

Java arrays

In Java, the result of a query for a set of objects is stored in arrays. The arrays are declared by you as a variable of the respective type, for example:

```
ProcessInstance[] processInstances;
```

With each new query, all existing objects in the array are deleted and the new objects are added.

The number of objects contained in an array is determined by accessing its length variable, for example:

```
processInstances.length
```

All array indexes start with 0 (zero). That is, valid index numbers are 0 to length-1. You access an object by providing its index number, for example, processInstances[0]. You should not save the index number of an object for later reuse, because the object can have a different index after each query, depending on the sort criteria and the number of objects returned.

Handling containers

A container represents input or output data of a process template, process instance, work item, or activity implementation at *runtime*. Each container is defined by a *data structure* which declares the container to be of the type of that data structure.

Data structure/container type

A data structure is uniquely identified by its name and contains an ordered list of *data members*. At runtime, it can become a stream of 32 KB passed between the client and the server.

The data structures and their usage as input containers or output containers are defined during modeling. A special data structure called DEFAULT_DATA_STRUCTURE is provided by MQSeries Workflow and contains no user-defined data members when installed. The DEFAULT_DATA_STRUCTURE cannot be deleted, but it can be extended during modeling.

Data member/container element

A data member of a data structure has a name and a *data type*. Data types are either basic and then STRING, LONG, BINARY, or FLOAT,or another data structure. Using a data structure as the data type of a data member (nesting) allows for recursive definitions of data members.

A data member can represent a one-dimensional array. If a data member represents an array, the number of elements in that array is shown in parentheses ().

A data structure can have up to 512 user-defined data members. A data member that represents an array of data members counts with as many data members as it has elements.

Data members are specified using their fully qualified name within the container. The fully qualified name of a data member is a name in dot notation where the hierarchy of nested data members is presented from left to right, and their names are separated by a dot.

If a data member actually specifies an array of data members, the index number of a specific data member is specified in brackets ([n]) or parentheses ((n)).

When a data structure denotes the type of a container, then its data members (first level of any hierarchy) are also called *container elements*. They define the *structural members* of the container. When the data type of a container element (n-th level of any hierarchy) is a data structure (nesting), then that container element again has container elements or structural members.

Container elements of a basic data type are also called the *leaves* of the container. These are the members which can hold a value, that is, which can be asked for a value and which can be set to a new value.

For example, assume that the data structure PERSON describes an input container or output container and that PERSON has been defined as:

```
Name          STRING
Addr          ADDRESS
  Street      STRING
  POBOX       LONG(2)
```

PERSON has two structural data members named Name and Addr. Name is of basic data type STRING and Addr is of data type ADDRESS. That is the data structure ADDRESS is nested within the data structure PERSON.

The input or output container described by PERSON then has two container elements or structural members named Name and Addr, where Addr defines a structure by itself. The container elements or structural members of the container element Addr are Street and POBOX.

The leaves of the container, that is, the container elements which can carry a value, and their fully qualified names within the container are:

```
Name
Addr.Street
Addr.POBOX[0]
Addr.POBOX[1]
```

Note that since the size of the POBOX array is 2, the valid index numbers are 0 and 1. This is because all array indexes start with 0 (zero).

Also note that the fully qualified names are not prefixed with the name of the data structure PERSON. That data structure denotes the type of the container. There is

only one exception to the rule, when the container itself is specified to be an array, for example, an array of PERSONs. Then, to set the name of a specific person, the fully qualified name is specified as

```
PERSON[i].Name
```

For detailed examples see "Chapter 6. Examples" on page 525.

In the XML message interface, arrays are depicted as a sequence of elements. Since the structure is given explicitly, names are not prefixed. For example:

```
<Name>
  <Addr>
    <Street></Street>
    <POBOX></POBOX>
    <POBOX></POBOX>
  </Addr>
</Name>
```

For more information refer to "XML message interface" on page 151.

Predefined data members

All containers automatically specify data members predefined by MQSeries Workflow. They can hold values associated with the operational characteristics of an activity or process. Predefined data members are data members that need not be defined by the modeler but are automatically available. They can be accessed by the container API. Their names start with the reserved character "_".

Predefined data member values can be:
- Used to evaluate activity exit criteria.
- Accessed by activity implementations.
- Dynamically set to change the operational characteristics of subsequent activities.

Predefined data members provide for the flexibility of modelers. The decision on operational characteristics of a process or activity is taken at Runtime. They also provide activity implementations and support tools a means to access the operational characteristics through the use of API calls.

There are the following sets of predefined data members:
- Fixed data members
- Process information data members
- Activity information data members

Fixed data members provide information about the current activity instance. They *cannot be set* using an API call. An exception is the _RC data member, which should be set only if the program cannot otherwise define a return code (see the following).

Process information and activity information data members are associated with the operational characteristics of a process or activity. They operate the same way as any user-defined data members. This means that the values for specific operational characteristics of a process instance or activity instance can be accessed or changed just like the values for any other user-defined data member.

The following provides the fully qualified name and a brief description of each of the predefined data members.

There are no arrays of any predefined data member.

Fixed data members

Fixed data members _ACTIVITY, _PROCESS, and _PROCESS_MODEL *cannot be set* using API calls. Their values *can be read* using container API calls.

_ACTIVITY
This data member contains the fully-qualified name of the considered activity instance. The value of this data member is automatically set when the activity instance or an associated work item is started.

Data type: STRING

_PROCESS
This data member contains the name of the associated process instance. The value of this data member is automatically set when the activity instance or an associated work item is started.

Data type: STRING

_PROCESS_MODEL
This data member contains the name of the associated process model. The value of this data member is automatically set when the activity instance or an associated work item is started.

Data type: STRING

_RC This data member contains the return code of the activity implementation. Typically it is used to evaluate exit and transition conditions. _RC is the only way for a CICS- or IMS-based application to set a return code. If the application does not set _RC explicitly (via the Container API), the field is automatically set to the exit code when program execution is completed.

Data type: LONG

Process information data members

Process information data members serve to dynamically specify properties of a process instance. In general, the process modeler can choose where values for process instance properties are to be obtained.

- Values can be inherited from a top-level process instance.
- Values can be obtained from the process information data members in the input container. They are then either set as default values or provided in the input container when the process instance is started.

If specified via the *DATA_FROM_INPUT_CONTAINER* indicator, the values of the process information data members are read by MQSeries Workflow when the process instance is started. If a value for a process information data member is not set, then a default value is used (see the detailed descriptions below).

_PROCESS_INFO.Role
A role that people assigned to an activity instance of the process instance must fulfill.

Any role set becomes an additional criterion to roles set for the activity instance. Only people who are members of all the specified roles are eligible.

If no role is set and no roles are specified for the activity instance, then no role criteria are applied.

Data type: STRING

_PROCESS_INFO.Organization
The organization to which people must belong to receive work items of the process instance. This setting is only used if no organization is specified for the activity instance.

If no organization is set and no organization is specified for the activity instance, the default is the organization of the person who starts the process instance.

Data type: STRING

_PROCESS_INFO.ProcessAdministrator
The user ID of the person notified if:
- The process instance is expired.
- No person meets the criteria to perform an activity instance.
- No valid person has been specified for notification.
- The person notified that an activity instance is overdue has exceeded the time allowed for an action, that is, the second notification is sent.

If not set, the default process administrator is the person who starts the process instance.

Data type: STRING

_PROCESS_INFO.Duration
Specifies how long the process instance is allowed to take. The value is expressed in seconds.

If not set, the default is "Endless".

Data type: LONG

Activity information data members

Activity information data members serve to dynamically specify properties of an activity instance. In general, the process modeler can choose where values for activity instance properties are to be obtained.

- Values can be obtained from the activity information data members in the input container. They are then either set as default values or provided in the input container when an activity instance or associated work item is started.

If specified, the values of the activity information data members are read by MQSeries Workflow when the activity instance is scheduled. If a value is not set, then a default value is used (see the detailed descriptions below).

The following indicators specify that activity information data members are to be read:
- DONE_BY STAFF DEFINED_IN INPUT_CONTAINER
- NOTIFICATION DEFINED_IN INPUT_CONTAINER
- PRIORITY DEFINED_IN INPUT_CONTAINER

_ACTIVITY_INFO.Priority
The numeric value assigned as the priority of an activity instance. MQSeries Workflow does not deduce any meaning from this value; it is just used for client purposes. Any integer value between 0 and 9 can be specified. If the value specified is invalid or the data member is not set, a default of 0 (zero) is used.

Data type: LONG

_ACTIVITY_INFO.MembersOfRoles

The role or roles a person must fulfill to receive a work item for the activity instance. Multiple roles may be specified and are then to be separated by a semicolon (;).

Any role or roles set for this data member become an additional criterion to the role set for the process instance. Only people who are members of all the specified roles are eligible.

If not set, the role specified for the process instance is used. If no role is set for the process instance and no roles are specified for the activity instance, then no role criteria are applied.

Note: This specification is ignored if any specific people are set using the `_ACTIVITY_INFO.People` data member.

Data type: STRING

_ACTIVITY_INFO.CoordinatorOfRole

The role or roles a person must coordinate to receive a work item for the activity instance. Multiple roles to coordinate may be specified and are then to be separated by a semicolon (;).

To receive a work item, the eligible person must be assigned as coordinator of all the specified roles in addition to being a member of all roles specified for the process instance and for the activity instance.

If not set, the roles specified by the process instance and the activity instance are solely used. If no roles to be member of nor roles to coordinate have been specified, no role criteria are applied.

Note: This criterion is ignored if any specific people are set using the `_ACTIVITY_INFO.People` data member.

Data type: STRING

_ACTIVITY_INFO.Organization

The organization to which people must belong to receive work items of the activity instance.

If an organization is set using this data member, any organization set for the process instance is ignored.

If not set, the organization specified by the process instance is used. If no organization is set and no organization is specified for the process instance properties, the default is the organization of the person who starts the process instance.

Note: This criterion is ignored if any specific people are set using the `_ACTIVITY_INFO.People` data member.

Data type: STRING

_ACTIVITY_INFO.OrganizationType

This data member is used to indicate if a work item for the activity instance should be assigned to persons in a child organization.

To make all persons in the specified organization and all of its child organizations eligible, set the value of this data member to 0.

To limit the persons who are eligible to the members of the specified organization and the managers of the first level of child organizations, set this data member to any nonzero value.

If not set, the default is 0. If no organization is set for the _ACTIVITY_INFO.Organization data member, any value set here is ignored.

Note: This criterion is ignored if any specific people are set using the _ACTIVITY_INFO.People data member.

Data type: long

_ACTIVITY_INFO.LowerLevel

The minimum level persons must have to receive work items of the activity instance. A value between 0 and 9 can be set. The default value is 0 (zero).

If the level specified here is greater than the value specified for the upper level, or if the level is not set, the default value of 0 (zero) is used.

Note: This criterion is ignored if any specific people are set using the _ACTIVITY_INFO.People data member.

Data type: LONG

_ACTIVITY_INFO.UpperLevel

The maximum level for persons to receive work items of the activity instance. A value between 0 and 9 can be set. The default value is 9.

If the level specified here is less than the value specified for the lower level, or the level is not set, the default value of 9 is used.

Note: This criterion is ignored if any specific people are set using the _ACTIVITY_INFO.People data member.

Data type: LONG

_ACTIVITY_INFO.People

This data member is used to specifically identify the people who should receive a work item of the activity instance. Multiple entries are possible and are then to be separated by a semicolon (;).

If any people are identified using this data member, any values set for data members _ACTIVITY_INFO.MembersOfRoles, _ACTIVITY_INFO.CoordinatorOfRole, _ACTIVITY_INFO.Organization, _ACTIVITY_INFO.OrganizationType, _ACTIVITY_INFO.LowerLevel, and _ACTIVITY_INFO.UpperLevel are ignored.

If no value is set, any values set for the above data members are used. If no values have been set for those, the values set for staff definition for the process instance are used.

If no values have been set for the process instance, the people in the organization and all child organizations of the process starter receive a work item for the activity instance.

Data type: STRING

_ACTIVITY_INFO.PersonToNotify

Used to identify the person to notify if the specified duration to complete the activity instance expires before the activity instance is complete.

If the user ID specified by the data member is invalid or the data member is not set, the process administrator is notified.

Data type: LONG

_ACTIVITY_INFO.Duration
Used to specify the maximum number of seconds allowed to complete the activity.

If the activity is not completed before the specified duration, the defined person is notified.

If the value specified by the data member is invalid or the data member is not set, no notification occurs.

Data type: LONG

_ACTIVITY_INFO.Duration2
Used to specify the maximum number of seconds allowed to act on an activity instance notification.

If the notification is not acted on before the specified number of seconds expires, the process administrator is notified.

If the value specified by the data member is invalid or the data member is not set, no notification occurs.

Data type: LONG

Determining the structure of an unknown container

There are various API calls in order to determine the structure of an unknown container and/or its leaves. Applied to a container, they return a collection of container elements. Once the collection of container elements is available, similar API calls can be recursively applied in order to step down through a nested structure.

Note: In the XML message interface, a container is always completely described in the message. An application can thus determine the structure of a container by analyzing the container in the message.

Determining the leaves

The following API calls allow to determine the number of leaves in a container or to retrieve the leaves themselves. When all leaves are requested, then not only the user-defined leaves or their leaf count are provided, but also the MQSeries Workflow predefined data members.

C

```
unsigned long FmcjContainerLeafCount( FmcjContainerHandle handle )

FmcjContainerElementVectorHandle
FmcjContainerLeaves( FmcjContainerHandle handle )

unsigned long FmcjContainerAllLeafCount( FmcjContainerHandle handle )

FmcjContainerElementVectorHandle
FmcjContainerAllLeaves( FmcjContainerHandle handle )
```

C++

```
unsigned long LeafCount()

void Leaves( vector<FmcjContainerElement> const & leaves ) const

unsigned long AllLeafCount()

void AllLeaves( vector<FmcjContainerElement> const & leaves ) const
```

Java

```
public abstract int leafCount() throws FmcException

public abstract ContainerElement[] leaves() throws FmcException

public abstract int allLeafCount() throws FmcException

public abstract ContainerElement[] allLeaves() throws FmcException
```

COBOL

```
        FmcjCLeafCount.

           CALL    "FmcjContainerLeafCount"
                          USING
                          BY VALUE
                             hdlContainer
                          RETURNING
                             ulongReturnValue.

        FmcjCLeaves.

           CALL    "FmcjContainerLeaves"
                          USING
                          BY VALUE
                             hdlContainer
                          RETURNING
                             FmcjCEVHandleReturnValue.

        FmcjCAllLeafCount.

           CALL    "FmcjContainerAllLeafCount"
                          USING
                          BY VALUE
                             hdlContainer
                          RETURNING
                             ulongReturnValue.

        FmcjCAllLeaves.

           CALL    "FmcjContainerAllLeaves"
                          USING
                          BY VALUE
                             hdlContainer
                          RETURNING
                             FmcjCEVHandleReturnValue.
```

Parameters

handle Input. The handle of the container to be queried.
leaves Input/Output. The vector or array of container elements to be filled.

Return type
ContainerElement[]/FmcjContainerElementVectorHandle
The container elements which are leaves.
unsigned long/int
The number of user-defined leaves or the number of all leaves, user-defined and predefined.

Determining the structural members

The following API calls allow to determine the number of structural members in a container or to retrieve the structural members themselves.

C

```
unsigned long FmcjContainerMemberCount( FmcjContainerHandle handle )

FmcjContainerElementVectorHandle
FmcjContainerStructMembers( FmcjContainerHandle handle )
```

C++

```
unsigned long MemberCount()

void StructMembers( vector<FmcjContainerElement> const & members ) const
```

Java

```
public abstract int memberCount() throws FmcException

public abstract ContainerElement[] structMembers() throws FmcException
```

COBOL

```
        FmcjCMemberCount.

           CALL    "FmcjContainerMemberCount"
                          USING
                          BY VALUE
                             hdlContainer
                          RETURNING
                             ulongReturnValue.

        FmcjCStructMembers.

           CALL    "FmcjContainerStructMembers"
                          USING
                          BY VALUE
                             hdlContainer
                          RETURNING
                             FmcjCEVHandleReturnValue.
```

Parameters

handle Input. The handle of the container to be queried.

members Input/Output. The vector or array of container elements to be filled.

Return type

ContainerElement[]/FmcjContainerElementVectorHandle
The container elements which are part of the container.

unsigned long/int
The number of structural members in the container.

Determining the type

The following API calls provide the type of a container, that is, the name of the associated data structure.

C

```
char * FmcjContainerType( FmcjContainerHandle handle,
                          char *              containerTypeBuffer,
                          unsigned long       bufferLength )
```

C++

```
string Type()
```

Java

```
public abstract String type() throws FmcException
```

COBOL

```
      FmcjCType.

           CALL    "FmcjContainerType"
                          USING
                          BY VALUE
                             hdlContainer
                             containerTypeBuffer
                             bufferLength
                          RETURNING
                             pointerReturnValue.
```

Parameters

bufferLength Input. The length of the buffer to contain the container type; must be at least FMC_CONTAINER_TYPE_LENGTH bytes.

containerTypeBuffer
Input/Output. The buffer to contain the container type.

handle Input. The handle of the container to be queried.

Return type

char*/string/String
The type of the container.

Analyzing a container element

Once a container element has been accessed, it can be asked for its properties, its name, whether it is a leaf and an array, or a structure itself. Calls to the container can then be applied recursively in order to step down through a nested structure.

Determining the name or type of a container element

The following API calls allow to determine the name of a container element or its type.

C

```
char* FmcjContainerElementName    (FmcjContainerElementHandle handle,
                                   char *                     buffer,
                                   unsigned long              bufferLength)

char* FmcjContainerElementFullName(FmcjContainerElementHandle handle,
                                   char *                     buffer,
                                   unsigned long              bufferLength)

char* FmcjContainerElementType    (FmcjContainerElementHandle handle,
                                   char *                     buffer,
                                   unsigned long              bufferLength)
```

C++

```
string Name() const

string FullName() const

string Type() const
```

Java

```
public abstract String name() throws FmcException

public abstract String fullName() throws FmcException

public abstract String type() throws FmcException
```

COBOL

```
FmcjCEName.

   CALL    "FmcjContainerElementName"
                  USING
                  BY VALUE
                     hdlElement
                     elementNameBuffer
                     bufferLength
                  RETURNING
                     pointerReturnValue.


FmcjCEFullName.

   CALL    "FmcjContainerElementFullName"
                  USING
                  BY VALUE
                     hdlElement
                     elementNameBuffer
                     bufferLength
                  RETURNING
                     pointerReturnValue.


FmcjCEType.

   CALL    "FmcjContainerElementType"
                  USING
                  BY VALUE
                     hdlElement
                     containerTypeBuffer
                     bufferLength
                  RETURNING
                     pointerReturnValue.
```

Parameters

bufferLength Input. The length of the buffer to be filled.

buffer Input/Output. The buffer to contain the container element name or type.

handle Input. The handle of the container element to be queried.

Return type

char*/string/String

The name or type of the container.

Determining the structural properties of a container element

The following API calls allow to determine whether the considered container element is a leaf or a structure by itself and whether it is denoted to be an array.

C

```
bool FmcjContainerElementIsArray ( FmcjContainerElementHandle handle )

bool FmcjContainerElementIsLeaf  ( FmcjContainerElementHandle handle )

bool FmcjContainerElementIsStruct( FmcjContainerElementHandle handle )
```

C++

```
bool IsArray () const

bool IsLeaf  () const

bool IsStruct() const
```

Java

```
public abstract boolean isArray () throws FmcException

public abstract boolean isLeaf  () throws FmcException

public abstract boolean isStruct() throws FmcException
```

COBOL

```
        FmcjCEIsArray.

           CALL    "FmcjContainerElementIsArray"
                          USING
                          BY VALUE
                             hdlElement
                          RETURNING
                             boolReturnValue.

        FmcjCEIsLeaf.

           CALL    "FmcjContainerElementIsLeaf"
                          USING
                          BY VALUE
                             hdlElement
                          RETURNING
                             boolReturnValue.

        FmcjCEIsStruct.

           CALL    "FmcjContainerElementIsStruct"
                          USING
                          BY VALUE
                             hdlElement
                          RETURNING
                             boolReturnValue.
```

Parameters

handle Input. The handle of the container element to be queried.

Return type

boolean/bool An indicator whether the container element is an array, a leaf, or a structure.

Determining the leaves of a container element

The following API calls allow to determine the number of leaves of a container element or to retrieve the leaves themselves.

C

```
unsigned long
FmcjContainerElementLeafCount( FmcjContainerElementHandle handle )

FmcjContainerElementVectorHandle
FmcjContainerElementLeaves( FmcjContainerElementHandle handle )
```

C++

```
unsigned long LeafCount()

void Leaves( vector<FmcjContainerElement> const & leaves ) const
```

Java

```
public abstract int leafCount() throws FmcException

public abstract ContainerElement[] leaves() throws FmcException
```

COBOL

```
        FmcjCELeafCount.

           CALL    "FmcjContainerElementLeafCount"
                          USING
                          BY VALUE
                             hdlElement
                          RETURNING
                             ulongReturnValue.

       FmcjCELeaves.

           CALL    "FmcjContainerElementLeaves"
                          USING
                          BY VALUE
                             hdlElement
                          RETURNING
                             FmcjCEVHandleReturnValue.
```

Parameters

handle Input. The handle of the container to be queried.

leaves Input/Output. The vector or array of container elements to be filled.

Return type

ContainerElement[]/FmcjContainerElementVectorHandle
The container elements which are leaves.

unsigned long/int
The number of user-defined leaves.

Determining the structural members of a container element

The following API calls allow to determine the number of structural members of a container element or to retrieve the structural members themselves.

C

```
unsigned long
FmcjContainerElementMemberCount( FmcjContainerElementHandle handle )

FmcjContainerElementVectorHandle
FmcjContainerElementStructMembers( FmcjContainerElementHandle handle )
```

C++

```
unsigned long MemberCount()

void StructMembers( vector<FmcjContainerElement> const & members ) const
```

Java

```
public abstract int memberCount() throws FmcException

public abstract ContainerElement[] structMembers() throws FmcException
```

COBOL

```
        FmcjCEMemberCount.

           CALL    "FmcjContainerElementMemberCount"
                          USING
                          BY VALUE
                             hdlElement
                          RETURNING
                             ulongReturnValue.

        FmcjCEStructMembers.

           CALL    "FmcjContainerElementStructMembers"
                          USING
                          BY VALUE
                             hdlElement
                          RETURNING
                             FmcjCEVHandleReturnValue.
```

Parameters

handle Input. The handle of the container element to be queried.

members Input/Output. The vector or array of container elements to be filled.

Return type

ContainerElement[]/FmcjContainerElementVectorHandle
The container elements which are structural members.

unsigned long/int
The number of structural members.

Determining the elements of an array

The following API calls allow to determine the number of elements in an array or to retrieve the elements themselves.

C

```
unsigned long
FmcjContainerElementCardinality( FmcjContainerElementHandle handle )

FmcjContainerElementVectorHandle
FmcjContainerElementArrayElements( FmcjContainerElementHandle handle )
```

C++

```
unsigned long Cardinality() const

void ArrayMembers( vector<FmcjContainerElement> const & elements ) const
```

Java

```
public abstract int cardinality() throws FmcException

public abstract ContainerElement[] arrayElements() throws FmcException
```

COBOL

```
        FmcjCECardinality.

           CALL    "FmcjContainerElementCardinality"
                          USING
                          BY VALUE
                             hdlElement
                          RETURNING
                             ulongReturnValue.

        FmcjCEArrayElements.

           CALL    "FmcjContainerElementArrayElements"
                          USING
                          BY VALUE
                             hdlElement
                          RETURNING
                             FmcjCEVHandleReturnValue.
```

Parameters

handle Input. The handle of the container element to be queried.

elements Input/Output. The vector or array of container elements to be filled.

Return type

ContainerElement[]/FmcjContainerElementVectorHandle

The container elements which are part of the queried array container element.

unsigned long
The cardinality of the array described by the container element.

Accessing a known container element

When you know the (dotted) name of a container element, that name can be used in order to directly access the container element without iterating and searching through the whole container structure.

C

```
APIRET FMC_APIENTRY FmcjContainerGetElement(
                    FmcjContainerHandle          handle,
                    char const *                 qualifiedName,
                    FmcjContainerElementHandle  * element      )
```

C++

```
APIRET GetElement( string const &         qualifiedName,
                   FmcjContainerElement & element      ) const
```

Java

```
public abstract
ContainerElement getElement( String qualifiedName ) throws FmcException
```

COBOL

```
        FmcjCGetElement.

           CALL    "FmcjContainerGetElement"
                          USING
                          BY VALUE
                             hdlContainer
                             qualifiedName
                          BY REFERENCE
                             element
                          RETURNING
                             intReturnValue.
```

Parameters

element	Output. The container element.
handle	Input. The handle of the container to be queried.
qualifiedName	Input. The fully qualified name of the container element.

Return type

APIRET	The return code from this API call.

Accessing a value of a container

The following API calls return the value of a container leaf.
FMC_ERROR_MEMBER_NOT_SET is returned if no information is available.

When the leaf is an array of values, an index must be specified. Since an index is to be specified, the fully qualified name must be given without the index or its brackets.

C

```
unsigned long
       FMC_APIENTRY FmcjContainerArrayBinaryLength(
                    FmcjContainerHandle     handle,
                    char const *            qualified name,
                    unsigned long           index )

APIRET FMC_APIENTRY FmcjContainerArrayBinaryValue(
                    FmcjContainerHandle     handle,
                    char const *            qualifiedName,
                    unsigned long           index,
                    FmcjBinary *            value,
                    unsigned long           bufferLength )

unsigned long
       FMC_APIENTRY FmcjContainerBinaryLength(
                    FmcjContainerHandle     handle,
                    char const *            qualified name )

APIRET FMC_APIENTRY FmcjContainerBinaryValue(
                    FmcjContainerHandle     handle,
                    char const *            qualifiedName,
                    FmcjBinary *            value,
                    unsigned long           bufferLength )
```

C

```
APIRET FMC_APIENTRY FmcjContainerArrayFloatValue(
                    FmcjContainerHandle    handle,
                    char const *           qualifiedName,
                    unsigned long          index,
                    double *               value        )

APIRET FMC_APIENTRY FmcjContainerFloatValue(
                    FmcjContainerHandle    handle,
                    char const *           qualifiedName,
                    double *               value        )
                    unsigned long          bufferLength )
```

C

```
APIRET FMC_APIENTRY FmcjContainerArrayLongValue(
                    FmcjContainerHandle    handle,
                    char const *           qualifiedName,
                    unsigned long          index,
                    long *                 value        )

APIRET FMC_APIENTRY FmcjContainerLongValue(
                    FmcjContainerHandle    handle,
                    long *                 value )
```

C

```
unsigned long
       FMC_APIENTRY FmcjContainerArrayStringLength(
                    FmcjContainerHandle    handle,
                    char const *           qualified name,
                    unsigned long          index )

APIRET FMC_APIENTRY FmcjContainerArrayStringValue(
                    FmcjContainerHandle    handle,
                    char const *           qualifiedName,
                    unsigned long          index,
                    char *                 value,
                    unsigned long          bufferLength )

unsigned long
        FMC_APIENTRY FmcjContainerStringLength(
                     FmcjContainerHandle   handle,
                     char const *          qualified name )

APIRET FMC_APIENTRY FmcjContainerStringValue(
                     FmcjContainerHandle   handle,
                     char const *          qualifiedName,
                     char *                value,
                     unsigned long         bufferLength )
```

C++

```
unsigned long BinaryLength( unsigned long index )

APIRET Value( string const &    qualifiedName,
              unsigned long     index,
              FmcjBinary *      value,
              unsigned long     bufferLength ) const

unsigned long BinaryLength()
```

C++

```
APIRET Value( string const &    qualifiedName,
              unsigned long     index,
              long &            value ) const

APIRET Value( string const a    qualifiedName,
              long &            value ) const
```

C++

```
APIRET Value( string const &    qualifiedName,
              unsigned long     index,
              double &          value ) const

APIRET Value( string const a    qualifiedName,
              double &          value ) const
```

C++

```
APIRET Value( string const &    qualifiedName,
              unsigned long     index,
              string &          value ) const

APIRET Value( string const a    qualifiedName,
              string &          value ) const
```

Java

```
public abstract
byte[] getBuffer2(  String qualifiedName,
                    int    index        ) throws FmcException

public abstract
byte[] getBuffer(   String qualifiedName ) throws FmcException
```

Java

```
public abstract
double getDouble2(  String qualifiedName,
                    int    index        ) throws FmcException

public abstract
double getDouble(   String qualifiedName ) throws FmcException
```

Java

```
public abstract
int getLong2(       String qualifiedName,
                    int    index        ) throws FmcException

public abstract
int getLong(        String qualifiedName ) throws FmcException
```

Java

```
public abstract
String getString2(  String qualifiedName,
                    int    index        ) throws FmcException
public abstract
String getString(   String qualifiedName ) throws FmcException
```

COBOL

```
FmcjCArrayBinaryLength.

   CALL    "FmcjContainerArrayBinaryLength"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                     indexValue
                  RETURNING
                     ulongReturnValue.


FmcjCArrayBinaryValue.

   CALL    "FmcjContainerArrayBinaryValue"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                     indexValue
                     pointerValue
                     dataLength
                  RETURNING
                     intReturnValue.

FmcjCBinaryLength.

   CALL    "FmcjContainerBinaryLength"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                  RETURNING
                     ulongReturnValue.


FmcjCBinaryValue.

   CALL    "FmcjContainerBinaryValue"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                     pointerValue
                     dataLength
                  RETURNING
                     intReturnValue.
```

COBOL

```
FmcjCArrayFloatValue.

   CALL    "FmcjContainerArrayFloatValue"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                     indexValue
                  BY REFERENCE
                     doubleValue
                  RETURNING
                     intReturnValue.

FmcjCFloatValue.

   CALL    "FmcjContainerFloatValue"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                  BY REFERENCE
                     doubleValue
                  RETURNING
                     intReturnValue.
```

COBOL

```
FmcjCArrayLongValue.

   CALL    "FmcjContainerArrayLongValue"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                     indexValue
                  BY REFERENCE
                     intValue
                  RETURNING
                     intReturnValue.

FmcjCLongValue.

   CALL    "FmcjContainerLongValue"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                  BY REFERENCE
                     intValue
                  RETURNING
                     intReturnValue.
```

COBOL

```
FmcjCArrayStringLength.

   CALL    "FmcjContainerArrayStringLength"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                     indexValue
                  RETURNING
                     ulongReturnValue.


FmcjCArrayStringValue.

   CALL    "FmcjContainerArrayStringValue"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                     indexValue
                     valueBuffer
                     bufferLength
                  RETURNING
                     intReturnValue.

FmcjCStringLength.

   CALL    "FmcjContainerStringLength"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                  RETURNING
                     ulongReturnValue.

FmcjCStringValue.

   CALL    "FmcjContainerStringValue"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                     valueBuffer
                     bufferLength
                  RETURNING
                     intReturnValue.
```

Parameters

bufferLength Input. The length of the buffer available for passing the value; must be greater than or equal to the actual length. Use the appropriate Length() API calls to determine the actual length.

handle Input. The handle of the container to be queried.

index Input. When the leaf is an array, the index of the array element to be queried.

isArray Input. If set to *True*, an array is to be queried and the index is used.

qualifiedName Input. The fully qualified name of the leaf within the container.

value Output. The value of the leaf.

Return type
byte[]/double/int/String
The leaf value.
unsigned long
The minimum required buffer length for reading the value.
APIRET The return code from this API call.

Accessing a value of a container element

The following API calls return the value of a container element leaf. When the leaf is an array of values, an index must be specified.
FMC_ERROR_MEMBER_NOT_SET is returned if no information is available. Note that, in contrast to querying container leaves, the name of the leaf need not be specified because the container element itself is the leaf queried.

C

```
unsigned long
       FMC_APIENTRY FmcjContainerElementArrayBinaryLength(
                    FmcjContainerElementHandle handle,
                    unsigned long              index )

APIRET FMC_APIENTRY FmcjContainerElementArrayBinaryValue(
                    unsigned long              index,
                    FmcjBinary *               value,
                    unsigned long              bufferLength )

unsigned long
       FMC_APIENTRY FmcjContainerElementBinaryLength(
                    FmcjContainerElementHandle handle )

APIRET FMC_APIENTRY FmcjContainerElementBinaryValue(
                    FmcjContainerElementHandle handle,
                    FmcjBinary *               value,
                    unsigned long              bufferLength )
```

C

```
APIRET FMC_APIENTRY FmcjContainerElementArrayFloatValue(
                    FmcjContainerElementHandle handle,
                    unsigned long              index,
                    double *                   value   )

APIRET FMC_APIENTRY FmcjContainerElementFloatValue(
                    FmcjContainerElementHandle handle,
                    double *                   value  )
```

C

```
APIRET FMC_APIENTRY FmcjContainerElementArrayLongValue(
                    FmcjContainerElementHandle handle,
                    unsigned long              index,
                    long *                     value  )

APIRET FMC_APIENTRY FmcjContainerElementLongValue(
                    FmcjContainerElementHandle handle,
                    long *                     value )
```

C

```
unsigned long
       FMC_APIENTRY FmcjContainerElementArrayStringLength(
                    FmcjContainerElementHandle handle,
                    unsigned long              index )

APIRET FMC_APIENTRY FmcjContainerElementArrayStringValue(
                    FmcjContainerElementHandle handle,
                    unsigned long              index,
                    char *                     value,
                    unsigned long              bufferLength )

unsigned long
        FMC_APIENTRY FmcjContainerElementStringLength(
                     FmcjContainerElementHandle handle    )

APIRET FMC_APIENTRY FmcjContainerElementStringValue(
                     FmcjContainerElementHandle handle,
                     char *                     value,
                     unsigned long              bufferLength )
```

C++

```
unsigned long BinaryLength( unsigned long index )

APIRET Value( unsigned long     index,
              FmcjBinary *      value,
              unsigned long     bufferLength ) const

unsigned long BinaryLength()

APIRET Value( FmcjBinary *      value,
              unsigned long     bufferLength ) const
```

C++

```
APIRET Value( unsigned long     index,
              long &            value ) const

APIRET Value( long &            value ) const

APIRET Value( unsigned long     index,
              double &          value ) const

APIRET Value( double &          value ) const

APIRET Value( unsigned long     index,
              string &          value ) const

APIRET Value( string &          value ) const
```

Java

```
public abstract
byte[] getBuffer2( int index ) throws FmcException

public abstract
byte[] getBuffer() throws FmcException

public abstract
double getDouble2( int index ) throws FmcException

public abstract
double getDouble() throws FmcException

public abstract
int getLong2( int index ) throws FmcException

public abstract
int getLong() throws FmcException

public abstract
String getString2( int index ) throws FmcException

public abstract
String getString() throws FmcException
```

COBOL

```
FmcjCEArrayBinaryLength.

   CALL    "FmcjContainerElementArrayBinaryLength"
                  USING
                  BY VALUE
                     hdlElement
                     indexValue
                  RETURNING
                     ulongReturnValue.


FmcjCEArrayBinaryValue.

   CALL    "FmcjContainerElementArrayBinaryValue"
                  USING
                  BY VALUE
                     hdlElement
                     indexValue
                     pointerValue
                     dataLength
                  RETURNING
                     intReturnValue

FmcjCEBinaryLength.

   CALL    "FmcjContainerElementBinaryLength"
                  USING
                  BY VALUE
                     hdlElement
                  RETURNING
                     ulongReturnValue.


FmcjCEBinaryValue.

   CALL    "FmcjContainerElementBinaryValue"
                  USING
                  BY VALUE
                     hdlElement
                     pointerValue
                     dataLength
                  RETURNING
                     intReturnValue.
```

COBOL

```
FmcjCEArrayFloatValue.

   CALL    "FmcjContainerElementArrayFloatValue"
                  USING
                  BY VALUE
                     hdlElement
                     indexValue
                  BY REFERENCE
                     doubleValue
                  RETURNING
                     intReturnValue.

FmcjCEFloatValue.

   CALL    "FmcjContainerElementFloatValue"
                  USING
                  BY VALUE
                     hdlElement
                  BY REFERENCE
                     doubleValue
                  RETURNING
                     intReturnValue.
```

COBOL

```
FmcjCEArrayLongValue.

   CALL    "FmcjContainerElementArrayLongValue"
                  USING
                  BY VALUE
                     hdlElement
                     indexValue
                  BY REFERENCE
                     intValue
                  RETURNING
                     intReturnValue.

FmcjCELongValue.

   CALL    "FmcjContainerElementLongValue"
                  USING
                  BY VALUE
                     hdlElement
                  BY REFERENCE
                     intValue
                  RETURNING
                     intReturnValue.
```

COBOL

```
FmcjCEArrayStringLength.

   CALL    "FmcjContainerElementArrayStringLength"
                  USING
                  BY VALUE
                     hdlElement
                     indexValue
                  RETURNING
                     ulongReturnValue.

FmcjCEArrayStringValue.

   CALL    "FmcjContainerElementArrayStringValue"
                  USING
                  BY VALUE
                     hdlElement
                     indexValue
                     valueBuffer
                     bufferLength
                  RETURNING
                     intReturnValue.

FmcjCEStringLength.

   CALL    "FmcjContainerElementStringLength"
                  USING
                  BY VALUE
                     hdlElement
                  RETURNING
                     ulongReturnValue.


FmcjCEStringValue.

   CALL    "FmcjContainerElementStringValue"
                  USING
                  BY VALUE
                     hdlElement
                     valueBuffer
                     bufferLength
                  RETURNING
                     intReturnValue.
```

Parameters

bufferLength Input. The length of the buffer available for passing the value; must be greater than or equal to the actual length. Use the appropriate Length() API calls to determine the actual length.

handle Input. The handle of the container element to be queried.

index Input. When the leaf is an array, the index of the array element to be queried.

value Output. The value of the leaf.

Return type

byte[]/double/int/String
The leaf value.

unsigned long
The minimum required buffer length for reading the value.

APIRET The return code from this API call.

Setting a value of a container

The following API calls allow to set the value of a container leaf.

When the leaf is an array of values, an index must be specified. Since an index is to be specified, the fully qualified name must be given without the index and its parentheses.

C

```
APIRET FMC_APIENTRY FmcjContainerSetArrayBinaryValue(
                    FmcjContainerHandle     handle,
                    char const *            qualifiedName,
                    unsigned long           index,
                    FmcjBinary const *      value,
                    unsigned long           dataLength )

APIRET FMC_APIENTRY FmcjContainerSetBinaryValue(
                    FmcjContainerHandle     handle,
                    char const *            qualifiedName,
                    FmcjBinary const *      value,
                    unsigned long           dataLength )
```

C

```
APIRET FMC_APIENTRY FmcjContainerSetArrayFloatValue(
                    FmcjContainerHandle    handle,
                    char const *           qualifiedName,
                    unsigned long          index,
                    double                 value        )

APIRET FMC_APIENTRY FmcjContainerSetFloatValue(
                    FmcjContainerHandle    handle,
                    char const *           qualifiedName,
                    double                 value        )
```

C

```
APIRET FMC_APIENTRY FmcjContainerSetArrayLongValue(
                    FmcjContainerHandle    handle,
                    char const *           qualifiedName,
                    unsigned long          index,
                    long                   value        )

APIRET FMC_APIENTRY FmcjContainerSetLongValue(
                    FmcjContainerHandle    handle,
                    long                   value )
```

C

```
APIRET FMC_APIENTRY FmcjContainerSetArrayStringValue(
                    FmcjContainerHandle    handle,
                    char const *           qualifiedName,
                    unsigned long          index,
                    char const *           value    )

APIRET FMC_APIENTRY FmcjContainerSetStringValue(
                     FmcjContainerHandle   handle,
                     char const *          qualifiedName,
                     char const *          value )
```

C++

```
APIRET Value( string const &      qualifiedName,
              unsigned long       index,
              FmcjBinary const *  value,
              unsigned long       dataLength ) const

APIRET Value( string const &      qualifiedName,
              FmcjBinary const *  value,
              unsigned long       dataLength ) const
```

C++

```
APIRET Value( string const &    qualifiedName,
              unsigned long     index,
              long              value ) const

APIRET Value( string const a    qualifiedName,
              long              value ) const
```

C++

```
APIRET Value( string const &    qualifiedName,
              unsigned long     index,
              double            value ) const

APIRET Value( string const a    qualifiedName,
              double            value ) const
```

C++

```
APIRET Value( string const &    qualifiedName,
              unsigned long     index,
              string const &    value       ) const

APIRET Value( string const &    qualifiedName,
              string const &    value       ) const
```

Java

```
public abstract
void setBuffer2(  String   qualifiedName,
                  int      index,
                  byte     value      []) throws FmcException

public abstract
void setBuffer(   String   qualifiedName,
                  byte     value[]      ) throws FmcException
```

Java

```
public abstract
void setDouble2(  String   qualifiedName,
                  int      index,
                  double   value        ) throws FmcException

public abstract
void setDouble(   String   qualifiedName,
                  double   value        ) throws FmcException
```

Java

```
public abstract
void setLong2(    String   qualifiedName,
                  int      index,
                  long     value        ) throws FmcException

public abstract
void setLong(     String   qualifiedName,
                  long     value        ) throws FmcException
```

Java

```
public abstract
void setString2(  String   qualifiedName,
                  int      index,
                  String   value        ) throws FmcException
public abstract
void setString(   String   qualifiedName,
                  String    value       ) throws FmcException
```

COBOL

```
FmcjRWCSetArrayBinaryValue.

   CALL    "FmcjReadWriteContainerSetArrayBinaryValue"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                     indexValue
                     pointerValue
                     dataLength
                  RETURNING
                     intReturnValue.

FmcjRWCSetBinaryValue.

   CALL    "FmcjReadWriteContainerSetBinaryValue"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                     pointerValue
                     dataLength
                  RETURNING
                     intReturnValue.
```

COBOL

```
FmcjRWCSetArrayFloatValue.

   CALL    "FmcjReadWriteContainerSetArrayFloatValue"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                     indexValue
                     doubleValue
                  RETURNING
                     intReturnValue.

FmcjRWCSetFloatValue.

   CALL    "FmcjReadWriteContainerSetFloatValue"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                     doubleValue
                  RETURNING
                     intReturnValue.
```

COBOL

```
FmcjRWCSetArrayLongValue.

   CALL    "FmcjReadWriteContainerSetArrayLongValue"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                     indexValue
                     intValue
                  RETURNING
                     intReturnValue.

FmcjRWCSetLongValue.

   CALL    "FmcjReadWriteContainerSetLongValue"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                     intValue
                  RETURNING
                     intReturnValue.
```

COBOL

```
FmcjRWCSetArrayStringValue.

   CALL    "FmcjReadWriteContainerSetArrayStringValue"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                     indexValue
                     pointerValue
                  RETURNING
                     intReturnValue.

FmcjRWCSetStringValue.

   CALL    "FmcjReadWriteContainerSetStringValue"
                  USING
                  BY VALUE
                     hdlContainer
                     qualifiedName
                     pointerValue
                  RETURNING
                     intReturnValue.
```

Parameters

dataLength Input. The length of the binary value.
handle Input. The handle of the container to be set.
index Input. When the leaf is an array, the index of the array element to be set.
isArray Input. If set to *True*, an array element is to be set and the index is used.
qualifiedName Input. The fully qualified name of the leaf within the container.
value Input. The value of the leaf. Note that values for leaves of type

BINARY must be specified as a sequence of two-digit hexadecimal numbers. For example, the string 'abc<cr><lf>'' would be represented as '6162630d0a' (where <cr> denotes the ASCII 'carriage return' character and <lf> denotes the ASCII line-feed character).

Return type

APIRET The return code from this API call.

Return codes/FmcException

The following return codes can be issued or described by the result object, or the following exceptions can be thrown. The number in parentheses indicates the integer value:

FMC_OK(0) The API call completed successfully.

FMC_ERROR_BUFFER(800)
The provided buffer is too small.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is expected, but 0 is passed.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the server.

FMC_ERROR_FORMAT(117)
The qualified name does not conform to the syntax rules.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is invalid; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_MEMBER_CANNOT_BE_SET(115)
The specified member is an MQSeries Workflow predefined fixed data member; it is for information only.

FMC_ERROR_MEMBER_NOT_FOUND(112)
The specified member is not part of the container or container element.

FMC_ERROR_MEMBER_NOT_SET(113)
The specified member has no value.

Monitoring a process instance

MQSeries Workflow allows for obtaining a monitor for a specified process instance. A process instance monitor typically allows for:

- Observing the progress of a process instance execution.
- Determining the state of execution, that is, to determine which activity instance is currently in progress, is waiting to be executed by whom, is InError and waiting for some action. It allows to determine whether notifications occurred because the maximum work time was exceeded.
- Viewing the history of execution, that is, what path has been taken through the process instance and why. It allows to determine where the bottlenecks of execution are or where the most time-consuming parts are.

Note: Monitoring a process instance is not supported in the XML message interface.

Obtaining a process instance monitor

Once a process instance[2] has been accessed, a **process instance monitor** can be obtained. The transient process instance monitor object then represents all information about activity instances directly contained in the described process instance as well as all information on control connector instances connecting those activity instances.

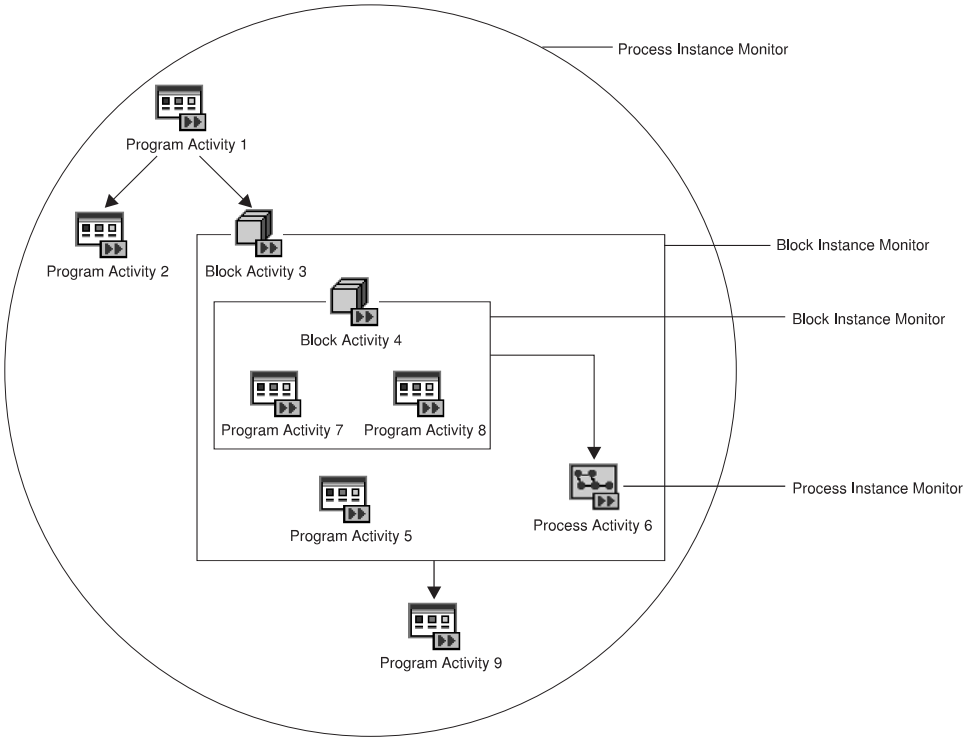


Figure 16. Process instance monitors and block instance monitors

For example, the illustrated process instance monitor describes three program activities, *Program Activity 1*, *Program Activity 2*, and *Program Activity 9*, and an activity of type Block, *Block Activity 3*. There are three control connectors between these activities.

The process instance monitor can then be asked for the activity instances and the control connector instances described and their properties can be determined, for example, the state of the activity and its graphical layout, or the result of control connector instance evaluation and activities to connect or bend points to be drawn.

When an activity of type *Block* is encountered, it is possible to obtain its **block instance monitor**. Similar to a process instance monitor, a block instance monitor object represents all information about activity instances directly contained in the described block activity instance as well as all information on control connector instances connecting those activity instances. For example, the block instance monitor of *Block Activity 3* describes *Block Activity 4*, *Program Activity 5*, and *Process Activity 6*. There is a control connector between *Block Activity 4* and *Process Activity 6*.

2. or activity instance or a (work) item

When an activity of type *Process* is encountered, it is again possible to obtain its process instance monitor, either via the embracing monitor object or by retrieving the implementing (sub)process instance of the activity and then obtaining the associated process instance monitor. The process instance monitor obtained is a monitor which is completely separate from any other process instance monitor.

When obtaining a process instance monitor, it is possible to use the *deep* option in order to specify that *all* monitors for activities of kind Block are to be returned from the MQSeries Workflow execution server in the same step. The block instance monitors then all show the state of the process instance at this retrieval time. This means, when a block instance monitor is obtained via an API call, the API finds this monitor in its cache and provides it to the caller. When the deep option is not used, it can happen that a block instance monitor is not available. The API then automatically fetches the requested monitor from the execution server; it then represents a newer state than the ones previously retrieved.

Note: The *deep* option is not yet supported.

Ownership of monitors

As any other transient object, a process instance monitor is owned by the caller of the API. When a process instance monitor is no longer needed, you should delete/deallocate the object.

A block instance monitor, however, is considered to be part of a process instance monitor. It is cached by the API as part of the process instance monitor. It cannot be deallocated in C or COBOL. Deletion in C++ only deletes the C++ representation but not the block instance monitor itself in the API cache. Block instance monitors are **automatically deleted** when the owning process instance monitor is deleted/deallocated. This means that block instance monitor objects or handles can only be used as long as the containing process instance monitor exists. When the process instance monitor no longer exists, using a block instance monitor object or handle will return unexpected results; your program can even abend since the usage of a nonexisting object or handle violates the MQSeries Workflow *programming by contract* concept.

Authorization considerations

In general, authorization is granted to persons, either explicitly or implicitly. Implicitly means that the authority has been given as the result of performing some MQSeries Workflow action; performing that action can itself request some specific authority. See also *MQSeries Workflow for OS/390: Customization and Administration*.

Special authority is granted to a person playing the role of a *system administrator*. The system administrator has all privileges except on (work) items. Only the owner of a (work) item can issue any actions; the system administrator can, however, transfer the (work) item to himself. The system administrator role must be assigned to a single person at any time.

When a process instance is started, its *process administrator* is determined. The person determined to be the process administrator receives process administration rights for that process instance.

The person who is to become the process administrator of a process instance is specified when the process model is defined. Identification of the process administrator can be done in the following ways:

- Specification of a user identification for the PROCESS_ADMINISTRATOR keyword. In this case, the process administrator is already known when the process model is defined.
- Specification of a member in the process input container via the PROCESS_ADMINISTRATOR TAKEN_FROM specification.
- Specification of DATA FROM INPUT_CONTAINER. The process administrator is then taken from the process information member _PROCESS_INFO.ProcessAdministrator field in the input container (see "Process information data members" on page 33 for details).

The following table shows the authorizations and the MQSeries Workflow functions which can be called when that authority has been granted. The E/I (Explicit/Implicit) column indicates how the authorization is granted to persons.

Note: For the programming language APIs, once a user has been authenticated to MQSeries Workflow (logged on), he can retrieve all objects he is authorized to see without any further special authorization. These are all objects he has created and all objects which are not specially secured or which are for public usage.

Table 2. Authorization for persons

Name	E/I	Authorized Functions
Authorization definition authorization	E	Create, update, and delete authorization information. Retrieve and update passwords. The appropriate FDL authorization keyword is AUTHORIZATION.
Operation administration authorization	E	Can perform all operation administration functions. The appropriate FDL authorization keyword is OPERATION.
Staff definition authorization	E	Create, retrieve, update, and delete staff information. As such, it includes authorization definition authorization. Create, retrieve, update, and delete public and private process instance lists, process template lists, and worklists. The appropriate FDL authorization keyword is STAFF.
Topology definition authorization	E	Create, retrieve, update, and delete topology information. The appropriate FDL authorization keyword is TOPOLOGY.
Process modeling authorization	E	Create, retrieve, update, and delete process models and process templates. The appropriate FDL authorization keyword is PROCESS_MODELING.

Table 2. Authorization for persons (continued)

Name	E/I	Authorized Functions
Process authorization	E	Can perform the following process instance functions if the process instance does not belong to any category. If the process instance does belong to a category, you must be authorized for all categories or for that specific category: • Create • Start • Create and start • Set process instance name • Query • Refresh Can perform the following process template functions if the process template does not belong to any category. If the process template does belong to a category, you must be authorized for all categories or for that specific category: • Query • Refresh The appropriate FDL authorization keyword is PROCESS_CATEGORY.
Process administration authorization	E	Has process authorization and can perform the following additional process instance functions if the process instance does not belong to any category. If the process instance does belong to a category, you must be authorized with administration rights for all categories or for that specific category: • Delete • Restart • Resume • Suspend • Terminate Can perform the following work item functions on the assigned work item for all process instances if the process instance does not belong to any category. If the process instance does belong to a category, you must be authorized for all categories or for that specific category: • Force-finish • Force-restart The appropriate FDL authorization keyword is PROCESS_CATEGORY AS ADMINISTRATOR.
Process administrator	I	Has process administration authority for the appropriate process instance.
Process creator	I	Can perform the following process instance functions: • Set process instance name • Delete, if not yet started • Query • Refresh • Start

Table 2. Authorization for persons (continued)

Name	E/I	Authorized Functions
Work item authority	E	Can perform the following functions on (work) items for all persons if you are authorized for all persons or for selected persons: • Query • Refresh • Transfer The appropriate FDL authorization keyword is WORKITEMS_OF.
Workitem owner	I	Can perform all functions on the assigned (work) item except: • Force Finish • Force Restart

Types of API calls

MQSeries Workflow API calls can be divided into several categories which characterize the kind and behavior of the request to be executed.

Basic	Manage transient objects
Accessor/mutator	Read and update properties of transient objects
Action	Read or manipulate persistent objects
Activity implementation	Deal with containers from within an activity implementation

Basic and accessor API calls are described in some detail, but still generally, in the following paragraphs. This is because all these API calls are similar in appearance and have similar requirements, even for different objects. They are all handled locally by the API, that is, they do not communicate with the server. The API calls of the other categories are described separately in "Chapter 5. API action and activity implementation calls" on page 287. These API calls require client/server communication or communication with the program execution server.

Basic API calls

Basic API calls are provided primarily to allow transient objects to be allocated or constructed and deallocated or destructed. They allow for the construction of supporting objects like service objects. They allow for the destruction of such objects as well as for the destruction of transient representations of persistent objects allocated implicitly by the MQSeries Workflow API. Refer also to "Object and memory management" on page 11.

Basic API calls are only provided in the various APIs as far as needed. For example, the Java language supports only IsComplete(), IsEmpty(), and the Agent constructor.

Because of the nature of transient objects, neither a connection to a server nor some specific authorization is required to execute.

Return codes

The C and COBOL calls and the MQSeries Workflow result object can return the following codes, the number in parentheses shows their integer value:

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is expected, but 0 is passed.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is invalid; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_INVALID_NAME(134)
The name provided is invalid; it is a null pointer or it does not conform to the syntax rules.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

Basic API calls allow for the basic operations listed below; **Xxx** and **Yyy** denote a particular class or scope, for example, FmcjXxxEqual() can stand for FmcjProcessInstanceEqual().

Allocation

The following API calls allow the application to set up the respective object. This is needed for supporting objects like string vectors. Transient objects representing persistent objects are allocated implicitly by the MQSeries Workflow API when persistent objects are created or queried from an MQSeries Workflow server.

In the C++ API, constructors are made public for **all** classes so that their instances can be put into collections. When they are called by the application, empty objects of the appropriate class are created; they do not yet represent a persistent object.

All constructed objects are transient.

C

```
APIRET FMC_APIENTRY
FmcjExecutionServiceAllocate( FmcjExecutionServiceHandle * service )

APIRET FMC_APIENTRY FmcjExecutionServiceAllocateForGroup(
                              char const *                systemGroup,
                              FmcjExecutionServiceHandle * service )

APIRET FMC_APIENTRY FmcjExecutionServiceAllocateForSystem(
                              char const *                system,
                              char const *                systemGroup,
                              FmcjExecutionServiceHandle * service )

APIRET FMC_APIENTRY
FmcjStringVectorAllocate( FmcjStringVectorHandle * hdlVector )
```

C++

```
FmcjXxx()

FmcjDateTime( bool initWithCurrentDateTime= false )

FmcjDateTime( unsigned short year,   unsigned short month,
              unsigned short day,    unsigned short hour,
              unsigned short minute, unsigned short second )
```

Java

```
Agent()
```

COBOL

```
        FmcjESAllocate.

           CALL    "FmcjExecutionServiceAllocate"
                          USING
                          BY REFERENCE
                             serviceValue
                          RETURNING
                             intReturnValue.

        FmcjESAllocateForGroup.

           CALL    "FmcjExecutionServiceAllocateForGroup"
                          USING
                          BY VALUE
                             systemGroup
                          BY REFERENCE
                             serviceValue
                          RETURNING
                             intReturnValue.

        FmcjESAllocateForSyst.

           CALL    "FmcjExecutionServiceAllocateForSystem"
                          USING
                          BY VALUE
                             system
                             systemGroup
                          BY REFERENCE
                             serviceValue
                          RETURNING
                             intReturnValue.

        FmcjStrVAllocate.

           CALL    "FmcjStringVectorAllocate"
                          USING
                          BY REFERENCE
                             hdlVector
                          RETURNING
                             intReturnValue.
```

Parameters

service Input/Output. The address of the handle to the object to be set when the object has been constructed. Ensure that the handle passed is not pointing to a still valid object, since that object is not automatically deallocated before the new object's handle is set.

initWithCurrentTime
Input. An indicator whether the date/time should be initialized with the current date/time.

system Input. The specific system where the execution server runs.

systemGroup
Input. The system group where the execution server resides. Specifying only the system group allows for exploiting the MQSeries clustering capabilities.
year/month/day
Input. The date part of the date/time.
hour/minute/second
Input. The time part of the date/time.

Return type
APIRET
The return code set by the allocation.
Object*
The newly constructed object.

Assignment

In the C++ API, the assignment operator allows the application to assign the contents of the specified object to the target object, and returns the target object. The assignment is achieved by deleting the target object before the contents are assigned from the specified object.

C++

```
FmcjXxx & operator=( FmcjXxx const & anObject )
```

Parameters
anObject Input. The object from which the contents are to be assigned.

Comparison/equality

The following API calls allow an application to compare two transient objects in order to determine whether they represent the same persistent or API object.

Normally, comparison is done on the basis of the object identifiers. True is returned if both transient objects represent the same persistent object. The contents of the transient objects to be compared are not further checked, that is, it is not checked whether both transient objects carry the same states of the persistent object.

Exceptions:

- Service objects are equal when they represent the same session.
- Error objects are equal when they report the same error, that is, when they contain the same return code and the same parameters.
- Program data objects are equal when they belong to the same work item.
- Control connector instance objects are equal when they have the same source and target activity instances.
- Point and symbol layout objects are equal when their properties are equal.

In C and COBOL, the return code of the result object is set to *invalid handle* if one of the handles passed is invalid. True is returned if both are invalid, else false.

C

```
bool FMC_APIENTRY FmcjXxxEqual(  FmcjXxxHandle  handle1,
                                 FmcjXxxHandle  handle2 )
```

C++

```
bool operator==( FmcjXxx const & anObject ) const
```

COBOL

```
      FmcjXxxEqual.
           CALL    "FmcjXxxEqual"
                          USING
                          BY VALUE
                             handle1
                             handle2
                          RETURNING
                             boolReturnValue.
```

Parameters

anObject Input. The object to be compared with this one.
handle1 Input. The first object to be compared.
handle2 Input. The other object to be compared.

Copy

The following API calls allow the application to make a copy of a particular transient object. That copy becomes a separate object and thus carries its own state.

An exception is the execution service where a copy points to the same session established by the original object. This especially means, when you request to log off on either object, then the (common) session is closed.

C

```
APIRET FMC_APIENTRY FmcjXxxCopy( FmcjXxxHandle   handle,
                                 FmcjXxxHandle * newHandle )
```

C++

```
FmcjXxx( FmcjXxx const & anObject )
```

COBOL

```
      FmcjXxxCopy.
           CALL    "FmcjXxxCopy"
                          USING
                          BY VALUE
                             handle
                          BY REFERENCE
                             newHandle
                          RETURNING
                             intReturnValue.
```

Parameters

anObject Input. The object to be copied.
handle Input. The handle of the object to be copied.
newHandle Input/Output. The address of a handle to be set when the object

has been constructed. Ensure that the handle passed is not pointing to a still valid object since that object is not automatically deallocated before the new object's handle is set.

Deallocation

The following API calls allow the application to delete the specified transient object. Deletion of a transient object has no impact on the represented persistent object, if any.

The C or COBOL handle is set to 0 so that it can no longer be used. The C++ destructor is automatically called when an instance of FmcjXxx is deleted.

C

```
APIRET FMC_APIENTRY FmcjXxxDeallocate( FmcjXxxHandle * handle )
```

C++

```
virtual FmcjXxx()
```

COBOL

```
        FmcjXxxDeallocate.

           CALL    "FmcjXxxDeallocate"
                          USING
                          BY REFERENCE
                             handle
                          RETURNING
                             intReturnValue.
```

Parameters

handle Input/Output. The address of the handle to the object to be deallocated.

IsComplete()

Returns true when the object has been completely read from an MQSeries Workflow server, that is, both primary and secondary properties are available (see also "Accessor API calls" on page 85).

C

```
bool FMC_APIENTRY FmcjXxxIsComplete( FmcjXxxHandle handle )
```

C++

```
bool IsComplete()
```

Java

```
public abstract boolean IsComplete() throws FmcException
```

COBOL

```
FmcjXxxIsComplete.

   CALL    "FmcjXxxIsComplete"
                  USING
                  BY VALUE
                     handle
                  RETURNING
                     boolReturnValue.
```

Parameters
handle Input. The handle of the object to be queried.

Return type
bool/boolean
True if the object has been completely read from the server, otherwise false.

IsEmpty()

Returns whether the transient object contains no actual data values yet. The transient object has just been created and still contains default values. It does not yet reflect a persistent object.

C++

```
bool IsEmpty()
```

Java

```
public abstract boolean IsEmpty() throws FmcException
```

Return type
bool/boolean
True if the object has not yet been read from the server, otherwise false.

Kind()

Returns the kind of the queried object.

C

```
enum FmcjXxxEnum FMC_APIENTRY FmcjXxxKind( FmcjXxxHandle handle )
```

C++

```
FmcjXxx::Enum Kind() const
```

Java

```
public abstract Enum kind() throws FmcException
```

COBOL

```
FmcjXxxKind.
     CALL    "FmcjXxxKind"
                    USING
                    BY VALUE
                       handle
                    RETURNING
                       intReturnValue.
```

Parameters

handle Input. The handle of the object to be queried.

Return type

FmcjXxxEnum/Enum

The kind of the object; some element of an enumeration - see also "Accessing an enumerated value" on page 88.

C example using basic functions

```
#include <stdio.h>
#include <fmcjcrun.h>
int main()
{
  APIRET                      rc;
  FmcjExecutionServiceHandle  service   = 0;
  FmcjWorkitemVectorHandle    wList     = 0;
  FmcjWorkitemHandle          workitem1 = 0;
  FmcjWorkitemHandle          workitem2 = 0;
  FmcjWorkitemHandle          workitem3 = 0;

  FmcjGlobalConnect();

  /* logon */
  FmcjExecutionServiceAllocate(&service);
  rc = FmcjExecutionServiceLogon( service,
                                  "USERID", "password",
                                   Fmc_SM_Default, Fmc_SA_Reset
                                );
  /*  Query Workitems */
  rc= FmcjExecutionServiceQueryWorkitems( service,
                                          FmcjNoFilter,
                                          FmcjNoSortCriteria,
                                          FmcjNoThreshold,
                                          &wList );
  printf( "\nQuery workitems returns rc : %u\n", rc );
  fflush(stdout);

  if ( rc == FMC_OK && FmcjWorkitemVectorSize(wList) >= 2 )
  {                                       /* access first element         */
    workitem1= FmcjWorkitemVectorFirstElement(wList);
    if ( FmcjWorkitemIsComplete(workitem1) )
      printf( "Surprise - more than primary data available\n" );
    else
      printf( "Primary data of first workitem available\n" );
    fflush(stdout);

                                          /* access next element          */
    workitem2= FmcjWorkitemVectorNextElement(wList) ;
    if ( FmcjWorkitemEqual(workitem1,workitem2) )
      printf( "Surprise - workitems are equal\n" );
    else
      printf( "Workitems represent different objects\n" );
    fflush(stdout);

                                          /* copy workitem                */
    FmcjWorkitemCopy(workitem1,&workitem3);
    if ( FmcjWorkitemEqual(workitem1,workitem3) )
      printf( "Workitems represent same persistent object\n" );
    else
      printf( "Surprise - workitems are not equal\n" );
    fflush(stdout);

                                          /* cleanup                      */
    FmcjWorkitemDeallocate(&workitem1);
    FmcjWorkitemDeallocate(&workitem2);
    FmcjWorkitemDeallocate(&workitem3);
  }
   FmcjWorkitemVectorDeallocate( &wList );
```

Figure 17. C example using basic functions (Part 1 of 2)

```
  /* logoff */
  FmcjExecutionServiceLogoff(service);
  FmcjExecutionServiceDeallocate(&service);

  FmcjGlobalDisconnect();
  return FMC_OK;
}
```

Figure 17. C example using basic functions (Part 2 of 2)

C++ example using basic methods

```
#include <iomanip.h>
#include <bool.h>
#include <vector.h>
#include <fmcjstr.hxx>
#include <fmcjprun.hxx>
int main()
{
  FmcjGlobal::Connect();
   // logon
  FmcjExecutionService service;
  APIRET rc = service.Logon("USERID", "password");

  FmcjWorkitem workitem1;
  if ( workitem1.IsEmpty() )
    cout << "Transient workitem object has been created" << endl;
  else
    cout << "Surprise - workitem contains actual data" << endl;


  // Query Workitems
  vector<FmcjWorkitem>        wList;
  rc= service.QueryWorkitems( FmcjNoFilter,
                              FmcjNoSortCriteria,
                              FmcjNoThreshold,
                              wList );
  cout << "Query workitems returns rc : " << rc << endl ;

  if ( rc == FMC_OK && wList.size() >= 2 )
  {
    workitem1= wList[0];              // assign first element
    if ( workitem1.IsComplete() )
      cout << "Surprise - more than primary data available" << endl;
    else
      cout << "Primary data of first workitem available" << endl;

    FmcjWorkitem workitem2= wList[1];  // access next element
    if ( workitem1 == workitem2 )
      cout << "Surprise - workitems are equal" << endl;
    else
      cout << "Workitems represent different objects" << endl;
                                      // copy workitem
    FmcjWorkitem workitem3(workitem1);
   if ( workitem1 == workitem3 )
      cout << "Workitems represent same persistent object" << endl;
    else
      cout << "Surprise - workitems are not equal" << endl;
   }                                   // destructors called automatically

  // logoff
  rc = service.Logoff();

  FmcjGlobal::Disconnect();
  return FMC_OK;
}                                     // destructors called automatically
```

Figure 18. C++ example using basic methods

COBOL example using basic calls

Note: The SETADDR routine, which sets a pointer item to the address of a given string, is listed in "Example of the use of strings" on page 150.

```
 IDENTIFICATION DIVISION.
 PROGRAM-ID. "BASIC".

 DATA DIVISION.

   WORKING-STORAGE SECTION.

   COPY fmcvars.
   COPY fmcconst.
   COPY fmcrcs.

   01 localUserID   PIC X(30) VALUE z"USERID".
   01 localPassword PIC X(30) VALUE z"PASSWORD".
   01 workitem1     USAGE IS POINTER VALUE NULL.
   01 workitem2     USAGE IS POINTER VALUE NULL.
   01 workitem3     USAGE IS POINTER VALUE NULL.

   LINKAGE SECTION.

   01 retCode            PIC S9(9) BINARY.

 PROCEDURE DIVISION USING retCode.

      PERFORM FmcjGlobalConnect.
* logon
      PERFORM FmcjESAllocate.

      CALL "SETADDR" USING localUserId userId.
      CALL "SETADDR" USING localPassword passwordValue.
      MOVE Fmc-SM-Default TO sessionMode.
      MOVE Fmc-SA-Reset TO absenceIndicator.
      PERFORM FmcjESLogon.
* Query Workitems
      CALL "SETADDR" USING FmcjNoFilter filter.
      CALL "SETADDR" USING FmcjNoSortCriteria sortCriteria.
      MOVE FmcjNoThreshold TO threshold.
      PERFORM FmcjESQueryWorkitems.
      SET hdlVector TO workitems.
      MOVE intReturnValue TO retCode.
      DISPLAY "Query Workitems returns rc : " retCode.

      IF retCode = FMC-OK
         PERFORM FmcjWIVSize
         IF ulongReturnValue >= 2
* access first element
            PERFORM FmcjWIVFirstElement
            SET workitem1 TO FmcjWIHandleReturnValue
            SET hdlItem TO workitem1
            PERFORM FmcjWIIsComplete
            IF boolReturnValue = 1
               DISPLAY "Surprise - more than primary data"
               DISPLAY "available"
            ELSE
               DISPLAY "Primary data of first workitem"
               DISPLAY "available"
            END-IF
```

Figure 19. COBOL example using basic calls (via PERFORM) (Part 1 of 2)

```
* access next element
            PERFORM FmcjWIVNextElement
            SET workitem2 TO FmcjWIHandleReturnValue
            SET hdlItem2 TO workitem2
            PERFORM FmcjWIEqual
            IF boolReturnValue = 1
               DISPLAY "Surprise - workitems are equal"
            ELSE
               DISPLAY "Workitems represent different objects"
            END-IF
* copy workitem
            SET hdlWorkitem TO workitem1
            PERFORM FmcjWICopy
            SET workitem3 TO newWorkItem
            SET hdlItem2 TO workitem3
            PERFORM FmcjWIEqual
            IF boolReturnValue = 0
               DISPLAY "Surprise - workitems are not equal"
            ELSE
               DISPLAY "Workitems represent same persistent"
               DISPLAY "objects"
            END-IF

* cleanup
            SET hdlWorkitem TO workitem1
            PERFORM FmcjWIDeallocate
            SET hdlWorkitem TO workitem2
            PERFORM FmcjWIDeallocate
            SET hdlWorkitem TO workitem3
            PERFORM FmcjWIDeallocate
         END-IF
      END-IF

      PERFORM FmcjWIVDeallocate.

* logoff
      PERFORM FmcjESLogoff.
      DISPLAY "Logged off".
      PERFORM FmcjESDeallocate.
      PERFORM FmcjGlobalDisconnect.
      MOVE FMC-OK TO retCode.
      GOBACK.

      COPY fmcperf.
```

Figure 19. COBOL example using basic calls (via PERFORM) (Part 2 of 2)

```
 IDENTIFICATION DIVISION.
 PROGRAM-ID. "BASIC".

 DATA DIVISION.

   WORKING-STORAGE SECTION.

   COPY fmcvars.
   COPY fmcconst.
   COPY fmcrcs.

   01 localUserID   PIC X(30) VALUE z"USERID".
   01 localPassword PIC X(30) VALUE z"PASSWORD".
   01 workitem1     USAGE IS POINTER VALUE NULL.
   01 workitem2     USAGE IS POINTER VALUE NULL.
   01 workitem3     USAGE IS POINTER VALUE NULL.

   LINKAGE SECTION.

   01 retCode            PIC S9(9) BINARY.

 PROCEDURE DIVISION USING retCode.

      CALL "FmcjGlobalConnect".
      CALL "FmcjExecutionServiceAllocate"
         USING BY REFERENCE serviceValue
         RETURNING intReturnValue.
* logon
      CALL "SETADDR" USING localUserId userId.
      CALL "SETADDR" USING localPassword passwordValue.
      CALL "FmcjExecutionServiceLogon"
         USING BY VALUE serviceValue
                        userID
                        passwordValue
                        Fmc-SM-Default
                        Fmc-SA-Reset
         RETURNING intReturnValue.
* Query Workitems
      CALL "SETADDR" USING FmcjNoFilter filter.
      CALL "SETADDR" USING FmcjNoSortCriteria sortCriteria.
      CALL "FmcjExecutionServiceQueryWorkitems"
         USING BY VALUE     serviceValue
                            filter
                            sortCriteria
                            FmcjNoThreshold
               BY REFERENCE workitems
         RETURNING intReturnValue.
      MOVE intReturnValue TO retCode.
      DISPLAY "Query Workitems returns rc : " retCode.

      IF retCode = FMC-OK
         CALL "FmcjWorkitemVectorSize"
            USING BY VALUE workitems
            RETURNING ulongReturnValue

         IF ulongReturnValue >= 2

* access first element
            CALL "FmcjWorkitemVectorFirstElement"
               USING BY VALUE workitems
```

Figure 20. COBOL example using basic calls (via CALL) (Part 1 of 3)

```
                   RETURNING FmcjWIHandleReturnValue
                SET workitem1 TO FmcjWIHandleReturnValue
                CALL "FmcjItemIsComplete"
                   USING BY VALUE workitem1
                   RETURNING boolReturnValue
                IF boolReturnValue = 1
                   DISPLAY "Surprise - more than primary data"
                   DISPLAY "available"
                ELSE
                   DISPLAY "Primary data of first workitem"
                   DISPLAY "available"
                END-IF

           * access next element
                CALL "FmcjWorkitemVectorNextElement"
                   USING BY VALUE workitems
                   RETURNING FmcjWIHandleReturnValue
                SET workitem2 TO FmcjWIHandleReturnValue
                CALL "FmcjItemEqual"
                   USING BY VALUE workitem1
                                  workitem2
                   RETURNING boolReturnValue
                IF boolReturnValue = 1
                   DISPLAY "Surprise - workitems are equal"
                ELSE
                   DISPLAY "Workitems represent different objects"
                END-IF

           * copy workitem
                CALL "FmcjWorkitemCopy"
                   USING BY VALUE workitem1
                         BY REFERENCE workitem3
                   RETURNING intReturnValue
                CALL "FmcjItemEqual"
                   USING BY VALUE workitem1
                                  workitem3
                   RETURNING boolReturnValue
                 IF boolReturnValue = 0
                   DISPLAY "Surprise - workitems are not equal"
                ELSE
                   DISPLAY "Workitems represent same persistent"
                   DISPLAY "objects"
                END-IF

           * cleanup
                CALL "FmcjWorkitemDeallocate"
                   USING BY REFERENCE workitem1
                   RETURNING intReturnValue
                CALL "FmcjWorkitemDeallocate"
                   USING BY REFERENCE workitem2
                   RETURNING intReturnValue
                CALL "FmcjWorkitemDeallocate"
                   USING BY REFERENCE workitem2
                   RETURNING intReturnValue
              END-IF
           END-IF
           CALL "FmcjWorkitemVectorDeallocate"
              USING BY REFERENCE workitems
              RETURNING intReturnValue.
```

Figure 20. COBOL example using basic calls (via CALL) (Part 2 of 3)

```
* logoff
      CALL "FmcjExecutionServiceLogoff"
         USING BY VALUE serviceValue
         RETURNING intReturnValue.
      DISPLAY "Logged off".
      CALL "FmcjExecutionServiceDeallocate"
         USING BY REFERENCE serviceValue
         RETURNING intReturnValue.
      CALL "FmcjGlobalDisconnect".
      MOVE FMC-OK TO retCode.
      GOBACK.
```

Figure 20. COBOL example using basic calls (via CALL) (Part 3 of 3)

Accessor API calls

Accessor API calls are provided so that properties of transient objects can be read or changed. If the transient object represents a persistent one, then the values that are returned reflect the state of the persistent object when it was retrieved and used to set the transient object or when it was created or updated. Retrieval is done from an MQSeries Workflow server using the appropriate create, query, or refresh API calls. Creation or update can be done on the client when the MQSeries Workflow server sends new information (pushes information).

Default values are provided to you as long as the transient object is *empty* or *not complete*, or when the accessed property is *optional* and not set.

Default values are: an empty string or buffer for character-valued properties, 0 (zero) for integer-valued properties, false for boolean-valued properties, a timestamp with all members set to 0 (zero) for time-valued properties, "NotSet" for enumeration-valued properties, and an empty vector for multi-valued properties.

A transient object just constructed in C++ or Java is called *empty* because it does not yet reflect any persistent object. You can use the *IsEmpty()* method to determine whether the transient object still contains the default values only. Note that no action API call can be executed on an empty object.

By default, the MQSeries Workflow API provides for two views of persistent objects. They divide the persistent object into so-called *primary* properties and so-called *secondary* properties. Primary properties are considered “more important” from an access point of view. They are immediately returned when objects are queried. Secondary properties, and a refresh of the primary properties, are only returned on an explicit Refresh() request; on a per-object basis. You can use the *IsComplete()* API call to determine whether both primary and secondary object values have been read from the server.

Besides being primary or secondary, properties of a persistent object can be optional. This means that they can carry a value or not. When a default value is returned to you, you can use the corresponding IsNull() API call to determine whether that value is a value explicitly set or whether that value actually denotes that no value has been set. For example, when Threshold() returns 0 (zero), the threshold can have been set to zero, that is, no object is returned to you, or the threshold can have been set to have no value, that is, all qualifying objects are returned to you. Java is able to return null objects so that an IsNull() method is not needed.

Note that ″null″ is a concept orthogonal to being completely read. As long as the object is not complete, IsNull() will return true for a secondary, optional property because nothing is known yet about the actual value and whether it has been set or not. For example, the documentation is a secondary and optional property of an object. When the object has been queried, then only the primary properties have been retrieved from the server. The Documentation() API call returns an empty string or buffer. To determine whether a documentation has been set at all, you can use the DocumentationIsNull() API call. The result will be “true” independent from the actual documentation setting as long as IsComplete() returns false. The documentation is assumed to be not set as long as the secondary data has not been retrieved.

Data values are accessible as long as the transient objects exist, regardless of the state of the persistent objects or of the current logon or logoff state. In general, you decide about the lifetime of your transient objects.

Because of the nature of transient objects, neither a connection to a server nor some specific authorization is required to access object properties or to update object properties of the transient object.

Return codes

Accessor API calls provide the value asked for as their return value. Default values are returned when an error occurred during the execution of the accessor API call. In C, C++, or COBOL, you can query the MQSeries Workflow result object for any errors encountered. Java throws an FmcException. The following codes can occur (the number in parentheses shows the integer value):

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is expected, but 0 is passed.

FMC_ERROR_BUFFER(800)
The buffer provided is too small to hold the largest possible value. See the appropriate header file or copybook for required lengths.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, default values are returned.

FMC_ERROR_DOES_NOT_EXIST(118)
The object does not exist. For example, the message was not found in the message catalog.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_INVALID_CONFIGURATION_ID(1022)
The configuration provided is invalid; it is 0 or does not conform to its syntax rules.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is invalid; it is 0 or is not pointing to an object of the requested type.

FMC_ERROR_INVALID_RESULT_HANDLE(814)
The handle of the result object provided is invalid; it is 0 or is not pointing to a result object.

FMC_ERROR_INVALID_TIME(802)
The time passed is invalid.

FMC_ERROR_MESSAGE_CATALOG(815)
The message catalog cannot be found..

FMC_ERROR_PROFILE(124)
The profile cannot be found or opened.

FMC_ERROR_PROGRAM_EXECUTION(126)
The API call is not called from within an activity implementation, for example, ProgramID(), or it is not valid from within an activity implementation, for example, SetConfiguration().

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call. For example, the activity implementation is not trusted and thus cannot receive its program ID.

FMC_ERROR_WRONG_STATE(120)
The API call cannot be executed because the object is in the wrong state. For example, the configuration cannot be changed after logon.

Accessor API calls allow for the operations listed below; **Xxx** denotes a particular class or scope, and "Property" denotes the property queried. For example, FmcjXxxProperty() can stand for FmcjItemDescription().

Accessing a value of type bool

Returns the value of a property of type *bool*. A default of *false* is returned if no information is available.

C

```
bool FMC_APIENTRY FmcjXxxProperty( FmcjXxxHandle handle )
```

C++

```
bool Property() const
```

Java

```
public abstract boolean property() throws FmcException
```

COBOL

```
      FmcjXxxProperty.
           CALL    "FmcjXxxProperty"
                          USING
                          BY VALUE
                             handle
                          RETURNING
                             boolReturnValue.
```

Parameters

handle Input. The handle of the object to be queried.

Return type

bool/ boolean The property value.

Declaration examples

C bool FMC_APIENTRY FmcjWorkitemManualStartMode(FmcjWorkitemHandle handle);

C++ bool ManualStartMode() const;

Java public abstract boolean manualStartMode() throws FmcException;

Accessing a value of type date/time

Returns the value of a date/time property. A zero timestamp is returned if no information is available.

C

```
FmcjCDateTime FMC_APIENTRY FmcjXxxProperty( FmcjXxxHandle handle )
```

C++

```
FmcjDateTime Property() const
```

Java

```
public abstract Calendar property() throws FmcException
```

COBOL

```
      FmcjXxxProperty.
           CALL    "FmcjXxxProperty"
                          USING
                          BY VALUE
                             handle
                          RETURNING
                             dateTimeReturnValue.
```

Parameters

handle Input. The handle of the object to be queried.

time Input/Output. The date/time object to be set.

Return type

FmcjCDateTime/ FmcjDateTime/Calendar

The property value.

Declaration examples

C FmcjCDateTime FMC_APIENTRY FmcjWorkitemEndTime(FmcjWorkitemHandle handle);

C++ FmcjDateTime EndTime() const;

Java public abstract Calendar endTime() throws FmcException;

Accessing an enumerated value

Returns an enumerating value of a property. It is strongly advised to use the symbolic names in order to determine the actual value instead of the corresponding integer values. It is not guaranteed that integer values always stay the same. For COBOL programs, the symbolic values are defined in file fmcconst.cpy.

"NotSet" or a similar indicator is returned if no information is available.

C

```
enum FmcjXxxEnum FMC_APIENTRY FmcjXxxProperty( FmcjXxxHandle handle )
```

C++

```
FmcjXxx::Enum Property() const
```

Java

```
public abstract Enum property() throws FmcException
```

COBOL

```
      FmcjXxxProperty.
           CALL    "FmcXxxProperty"
                          USING
                          BY VALUE
                             handle
                          RETURNING
                             intReturnValue.
```

Parameters

handle Input. The handle of the object to be queried.

Return type

FmcjXxxEnum/Enum

The property value, some element of an enumeration.

Declaration examples

C	FmcjItemAssignReason FMC_APIENTRY FmcjWorkitemReceivedAs(FmcjWorkitemHandle handle);
C++	FmcjItem::AssignReason ReceivedAs() const;
Java	public abstract AssignReason receivedAs() throws FmcException;

The following enumeration types and constants are defined. Numbers in parentheses are the corresponding integer values. You are strongly advised to use the symbolic names only.

- FmcjItemAssignReason/ FmcjItem::AssignReason/ com.ibm.workflow.api.ItemPackage.AssignReason

  NotSet(0) Indicates that nothing is known about the assign reason.

C	Fmc_IR_NotSet
C++	FmcjItem::NotSpecified
Java	AssignReason.NOT_SPECIFIED
COBOL	Fmc-IR-NotSet

Normal(1) Indicates that the work item or notification has been assigned to the user because the user qualified to receive the item.

C	Fmc_IR_Normal
C++	FmcjItem::Normal
Java	AssignReason.NORMAL
COBOL	Fmc-IR-Normal

Substitute(2) Indicates that the work item or notification has been assigned because the user is the substitute for the person who should have received the item.

C	Fmc_IR_Substitute
C++	FmcjItem::Substitute
Java	AssignReason.Substitute
COBOL	Fmc-IR-Substitute

ProcessAdministrator(3)
Indicates that the work item or notification has been assigned because the user is the process administrator.

C	Fmc_IR_ProcessAdministrator
C++	FmcjItem::ProcessAdministrator
Java	AssignReason.PROCESS_ADMINISTRATOR
COBOL	Fmc-IR-ProcAdministrator

SystemAdministrator(4)
Indicates that the work item or notification has been assigned because the user is the system administrator.

C	Fmc_IR_SystemAdministrator
C++	FmcjItem::SystemAdministrator
Java	AssignReason.SYSTEM_ADMINISTRATOR
COBOL	Fmc-IR-SystAdministrator

ByTransfer(5) Indicates that the work item or notification has been transferred to the user.

C	Fmc_IR_ByTransfer
C++	FmcjItem::ByTransfer
Java	AssignReason.BY_TRANSFER
COBOL	Fmc-IR-ByTransfer

- FmcjProcessTemplateAuditSetting/ FmcjProcessTemplate::AuditSetting/ com.ibm.workflow.api.ProcessTemplatePackage.AuditSetting

NotSet(0) Indicates that nothing is known about the audit setting.

C	Fmc_TA_NotSet
C++	FmcjProcessTemplate::NotSet
Java	AuditSetting.NOT_SET
COBOL	Fmc-TA-NotSet

NoAudit(1) Indicates that auditing is not to be performed.

C Fmc_TA_NoAudit

C++ FmcjProcessTemplate::NoAudit

Java AuditSetting.NO_AUDIT

COBOL Fmc-TA-NoAudit

Condensed(2) Indicates that condensed auditing is to be performed.

C Fmc_TA_Condensed

C++ FmcjProcessTemplate::Condensed

Java AuditSetting.CONDENSED

COBOL Fmc-TA-Condensed

Full(3) Indicates that full auditing is to be performed.

C Fmc_TA_Full

C++ FmcjProcessTemplate::Full

Java AuditSetting.FULL

COBOL Fmc-TA-Full

- FmcjActivityInstanceEscalation/ FmcjActivityInstance::Escalation/ com.ibm.workflow.api.ActivityInstancePackage.Escalation

  NotSet(0) Indicates that it is not known whether there is a notification on the activity instance.

  C Fmc_AE_NotSet

  C++ FmcjActivityInstance::NotSpecified

  Java Escalation.NOT_SPECIFIED

  COBOL Fmc-AE-NotSet

  NoNotification(1)
  Indicates that no notification occurred so far on the activity instance.

  C Fmc_AE_NoNotification

  C++ FmcjActivityInstance::NoNotification

  Java Escalation.NO_NOTIFICATION

  COBOL Fmc-AE-NoNotif

  FirstNotification
  Indicates that the first notification occurred.

  C(4) Fmc_AE_FirstNotification

  C++(4) FmcjActivityInstance::FirstNotification

  Java(2) Escalation.FIRST_NOTIFICATION

  COBOL(4) Fmc-AE-FirstNotif

  SecondNotification
  Indicates that the second notification occurred.

  C(5) Fmc_AE_SecondNotification

  C++(5) FmcjActivityInstance::SecondNotification

  Java(3) Escalation.SECOND_NOTIFICATION

COBOL(5) Fmc-AE-SecNotif

- FmcjActivityInstanceStateValue/ FmcjActivityInstance::state/ com.ibm.workflow.api.ActivityInstancePackage.ExecutionState

  NotSet(0) Indicates that nothing is known about the state of the activity instance.

  C Fmc_AS_NotSet

  C++ FmcjActivityInstance::undefined

  Java ExecutionState.UNDEFINED

  COBOL Fmc-AS-NotSet

  Ready(1) Indicates that the activity instance is in the ready state.

  C Fmc_AS_Ready

  C++ FmcjActivityInstance::ready

  Java ExecutionState.READY

  COBOL Fmc-AS-Ready

  Running(2) Indicates that the activity instance is in the running state.

  C Fmc_AS_Running

  C++ FmcjActivityInstance::running

  Java ExecutionState.RUNNING

  COBOL Fmc-AS-Running

  Finished Indicates that the activity instance is in the finished state.

  C(4) Fmc_AS_Finished

  C++(4) FmcjActivityInstance::finished

  Java(3) ExecutionState.FINISHED

  COBOL(4) Fmc-AS-Finished

  Terminated Indicates that the activity instance is in the terminated state.

  C(8) Fmc_AS_Terminated

  C++(8) FmcjActivityInstance::terminated

  Java(4) ExecutionState.TERMINATED

  COBOL(8) Fmc-AS-Term

  Suspended Indicates that the activity instance is in the suspended state.

  C(16) Fmc_AS_Suspended

  C++(16) FmcjActivityInstance::suspended

  Java(5) ExecutionState.SUSPENDED

  COBOL(16) Fmc-AS-Suspended

  Inactive Indicates that the activity instance is still inactive.

  C(32) Fmc_AS_Inactive

  C++(32) FmcjActivityInstance::inactive

  Java(6) ExecutionState.INACTIVE

	COBOL(32)	Fmc-AS-Inactive
CheckedOut	Indicates that the activity instance has been checked out.	
	C(64)	Fmc_AS_CheckedOut
	C++(64)	FmcjActivityInstance::checkedOut
	Java(7)	ExecutionState.CHECKED_OUT
	COBOL(64)	Fmc-AS-CheckedOut
InError	Indicates that the activity instance has not been executed successfully.	
	C(128)	Fmc_AS_InError
	C++(128)	FmcjActivityInstance::inError
	Java(8)	ExecutionState.IN_ERROR
	COBOL(128)	Fmc-AS-InError
Executed	Indicates that the activity instance has been executed.	
	C(256)	Fmc_AS_Executed
	C++(256)	FmcjActivityInstance::executed
	Java(9)	ExecutionState.EXECUTED
	COBOL(256)	Fmc-AS-Executed
Planning	Indicates that the activity instance is in the planning state.	
	C(512)	Fmc_AS_Planning
	C++(512)	FmcjActivityInstance::planning
	Java(10)	ExecutionState.PLANNING
	COBOL(512)	Fmc-AS-Planning
ForceFinished	Indicates that the activity instance is in the force-finished state.	
	C(1024)	Fmc_AS_ForceFinished
	C++(1024)	FmcjActivityInstance::forceFinished
	Java(11)	ExecutionState.FORCE_FINISHED
	COBOL(1024)	Fmc-AS-Force-Finished
Skipped	Indicates that the activity instance has not been executed but skipped.	
	C(2048)	Fmc_AS_Skipped
	C++(2048)	FmcjActivityInstance::skipped
	Java(12)	ExecutionState.SKIPPED
	COBOL(2048)	Fmc-AS-Skipped
Deleted	Indicates that the activity instance has been deleted.	
	C(4096)	Fmc_AS_Deleted
	C++(4096)	FmcjActivityInstance::deleted
	Java(13)	ExecutionState.DELETED
	COBOL(4096)	Fmc-AS-Deleted

Terminating Indicates that the activity instance is in the terminating state.

C(8192)	Fmc_AS_Terminating
C++(8192)	FmcjActivityInstance::terminating
Java(14)	ExecutionState.TERMINATING
COBOL(8192)	Fmc-AS-Terminating

Suspending Indicates that the activity instance is in the suspending state.

C(16384)	Fmc_AS_Suspending
C++(16384)	FmcjActivityInstance::suspendting
Java(15)	ExecutionState.SUSPENDING
COBOL(16384)	Fmc-AS-Suspending

- FmcjActivityInstanceType/ FmcjActivityInstance::Type/ com.ibm.workflow.api.ActivityInstancePackage.Type

NotSet(0) Indicates that nothing is known about the type of the activity instance.

C	Fmc_AT_NotSet
C++	FmcjActivityInstance::NotSet
Java	Type.NOT_SET
COBOL	Fmc-AT-NotSet

Process(1) Indicates that the activity instance is implemented by a process.

C	Fmc_AT_Process
C++	FmcjActivityInstance::Process
Java	Type.PROCESS
COBOL	Fmc-AT-Proc

Program(2) Indicates that the activity instance is implemented by a program.

C	Fmc_AT_Program
C++	FmcjActivityInstance::Program
Java	Type.PROGRAM
COBOL	Fmc-AT-Program

Block Indicates that the activity instance is implemented by a block.

C(16)	Fmc_AT_Block
C++(16)	FmcjActivityInstance::Block
Java(3)	Type.BLOCK
COBOL(16)	Fmc-AT-Block

- FmcjControlConnectorInstanceStateValue/ FmcjControlConnectorInstance::state/ com.ibm.workflow.api.ControlConnectorInstancePackage.EvaluationState

False(0) Indicates that evaluation of the control connector resulted in False.

C	Fmc_CS_False

C++ FmcjControlConnectorInstance::False

Java EvaluationState.IS_FALSE

COBOL Fmc-CS-False

True(1) Indicates that evaluation of the control connector resulted in True.

C Fmc_CS_True

C++ FmcjControlConnectorInstance::True

Java EvaluationState.IS_TRUE

COBOL Fmc-CS-True

NotEvaluated(2)
Indicates that the control connector has not yet been evaluated.

C Fmc_CS_NotEvaluated

C++ FmcjControlConnectorInstance::NotEvaluated

Java EvaluationState.NOT_EVALUATED

COBOL Fmc-CS-NotEvaluated

NotSet(3) Indicates that nothing is known about the evaluation of the control connector.

C Fmc_CS_NotSet

C++ FmcjControlConnectorInstance::NotSet

Java EvaluationState.NOT_SET

COBOL Fmc-CS-NotSet

- FmcjControlConnectorInstanceType/ FmcjControlConnectorInstance::Type/ com.ibm.workflow.api.ControlConnectorInstancePackage.Type

  NotSet(0) Indicates that nothing is known about the type of the control connector instance.

  C Fmc_CT_NotSet

  C++ FmcjControlConnectorInstance::Undefined

  Java Type.UNDEFINED

  COBOL Fmc-CT-NotSet

  Condition(1) Indicates that the control connector instance is a connector which can have a transition condition.

  C Fmc_CT_Condition

  C++ FmcjControlConnectorInstance::Condition

  Java Type.CONDITION

  COBOL Fmc-CT-Condition

  Otherwise(2) Indicates that the control connector instance is the “otherwise” connector.

  C Fmc_CT_Otherwise

  C++ FmcjControlConnectorInstance::Otherwise

  Java Type.OTHERWISE

COBOL Fmc-CT-Otherwise

- FmcjProgramTemplateExeMode/ FmcjProgramTemplate::ExeMode

  NotSet(0) Indicates that nothing is known about the execution mode.

  C Fmc_GM_NotSet

  C++ FmcjProgramTemplate::NotSet

  COBOL Fmc-GM-NotSet

  Normal(1) Indicates that the program does not participate in global transactions.

  C Fmc_GM_Normal

  C++ FmcjProgramTemplate::Normal

  COBOL Fmc-GM-Normal

  Safe(2) Indicates that the program participates in global transactions.

  C Fmc_GM_Safe

  C++ FmcjProgramTemplate::Safe

  COBOL Fmc-GM-Safe

- FmcjExeOptionsStyle/ FmcjExeOptions::Style/ com.ibm.workflow.api.ProgramDataPackage.Style

  NotSet(0) Indicates that nothing is known about the style of the EXE.

  C Fmc_EO_NotSet

  C++ FmcjExeOptions::NotSet

  Java Style.NOT_SET

  COBOL Fmc-EO-NotSet

  Visible(1) Indicates that the EXE should start visibly.

  C Fmc_EO_Visible

  C++ FmcjExeOptions::Visible

  Java Style.VISIBLE

  COBOL Fmc-EO-Visible

  Invisible(2) Indicates that the EXE should start invisibly.

  C Fmc_EO_Invisible

  C++ FmcjExeOptions::Invisible

  Java Style.INVISIBLE

  COBOL Fmc-EO-Invisible

  Minimized(3) Indicates that the EXE should start minimized.

  C Fmc_EO_Minimized

  C++ FmcjExeOptions::Minimized

  Java Style.MINIMIZED

  COBOL Fmc-EO-Minimized

  Maximized(4) Indicates that the EXE should start maximized.

C Fmc_EO_Maximized

C++ FmcjExeOptions::Maximized

Java Style.MAXIMIZED

COBOL Fmc-EO-Maximized

- FmcjProgramTemplateExeUser/ FmcjProgramTemplate::ExeUser

  NotSet(0) Indicates that nothing is known about the execution user.

  C Fmc_GU_NotSet

  C++ FmcjProgramTemplate::NotSpecified

  COBOL Fmc-GU-NotSet

  Agent(1) Indicates that the program executes under the identifier of the program execution server.

  C Fmc_GU_Agent

  C++ FmcjProgramTemplate::Agent

  COBOL Fmc-GU-Agent

  Starter(2) Indicates that the program executes under the user ID of the starter of the program.

  C Fmc_GU_Starter

  C++ FmcjProgramTemplate::Starter

  COBOL Fmc-GU-Starter

- FmcjExternalOptionsTimePeriod/ FmcjExternalOptions::TimePeriod/ com.ibm.workflow.api.ProgramDataPackage.TimePeriod

  NotSet(0) Indicates that nothing is known about an external service timeout.

  C Fmc_EX_NotSet

  C++ FmcjExternalOptions::NotSet

  Java TimePeriod.NOT_SET

  COBOL Fmc-EX-NotSet

  TimeInterval(1)
  Indicates that the program execution server should wait a specified time interval for the answer of the started external service.

  C Fmc_EX_TimeInterval

  C++ FmcjExternalOptions::TimeInterval

  Java TimePeriod.TIME_INTERVAL

  COBOL Fmc-EX-TimeInterval

  Forever(2) Indicates that the program execution server should wait forever for the answer of the started external service, that is, whatever time it takes.

  C Fmc_EX_Forever

  C++ FmcjExternalOptions::Forever

  Java TimePeriod.FOREVER

COBOL Fmc-EX-Forever

Never(3) Indicates that the program execution server should not wait for an answer of the started external service.

C Fmc_EX_Never

C++ FmcjExternalOptions::Never

Java TimePeriod.NEVER

COBOL Fmc-EX-Never

- FmcjExecutionDataKindEnum/ FmcjExecutionData::KindEnum

NotSet(0) Indicates that nothing is known about the type of the execution data.

C Fmc_DART_NotSet

C++ FmcjExecutionData::NotSet

Java not supported

COBOL Fmc-DART-NotSet

Error(1) Indicates that execution of an asynchronous call returns an error.

C Fmc_DART_Error

C++ FmcjExecutionData::Error

Java not supported

COBOL Fmc-DART-Error

Terminate(2) Indicates that receiving execution data can end.

C Fmc_DART_Terminate

C++ FmcjExecutionData::Terminate

Java not supported

COBOL Fmc-DART-Terminate

ItemDeleted(1000)
Indicates that the execution data describes the deletion of a work item or notification.

C Fmc_DART_ItemDeleted

C++ FmcjExecutionData::ItemDeleted

Java not supported

COBOL Fmc-DART-ItemDeleted

Workitem(1002)
Indicates that the execution data describes the creation or update of a work item.

C Fmc_DART_Workitem

C++ FmcjExecutionData::Workitem

Java not supported

COBOL Fmc-DART-Workitem

ActivityInstanceNotification(1003)
Indicates that the execution data describes the creation or update of an activity instance notification.

C	Fmc_DART_ActivityInstanceNotification
C++	FmcjExecutionData::ActivityInstanceNotification
Java	not supported
COBOL	Fmc-DART-ActInstNotif

ProcessInstanceNotification(1004)
Indicates that the execution data describes the creation or update of a process instance notification.

C	Fmc_DART_ProcessInstanceNotification
C++	FmcjExecutionData::ProcessInstanceNotification
Java	not supported
COBOL	Fmc-DART-ProcInstNotif

ExecuteInstanceResponse(1100)
Indicates that the execution data describes the answer to an asynchronous request which asked for the creation and execution of a process instance.

C	Fmc_DART_ProcessInstanceNotification
C++	FmcjExecutionData::ProcessInstanceNotification
Java	not supported
COBOL	Fmc-DART-ExecuteInstResponse

ExecuteProgramResponse(1101)
Indicates that the execution data describes the answer to an asynchronous request which asked for the execution of a program.

C	Fmc_DART_ExecuteProgramResponse
C++	FmcjExecutionData::ExecuteProgramResponse
Java	not supported
COBOL	Fmc-DART-ExecuteProgResponse

- FmcjImplementationDataBasis/ FmcjImplementationData::Basis/ com.ibm.workflow.api.ProgramDataPackage.Basis

NotSet(0) Indicates that nothing is known about the operating system platform of the implementing program.

C	Fmc_DP_NotSet
C++	FmcjImplementationData::NotSpecified
Java	Basis.NOT_SET
COBOL	Fmc-DP-NotSet

OS2(1) Indicates that the program is an OS/2 program.

C	Fmc_DP_OS2
C++	FmcjImplementationData::OS2
Java	Basis.OS2

	COBOL	Fmc-DP-OS2
AIX(2)	Indicates that the program is an AIX program.	
	C	Fmc_DP_AIX
	C++	FmcjImplementationData::AIX
	Java	Basis.AIX
	COBOL	Fmc-DP-AIX
HPUX(3)	Indicates that the program is an HP-UX program.	
	C	Fmc_DP_HPUX
	C++	FmcjImplementationData::HPUX
	Java	Basis.HPUX
	COBOL	Fmc-DP-HPUX
Windows95(4)	Indicates that the program is a Windows 95 program.	
	C	Fmc_DP_Windows95
	C++	FmcjImplementationData::Windows95
	Java	Basis.WINDOWS_95
	COBOL	Fmc-DP-Windows95
WindowsNT(5)	Indicates that the program is a Windows NT program.	
	C	Fmc_DP_WindowsNT
	C++	FmcjImplementationData::WindowsNT
	Java	Basis.WINDOWS_NT
	COBOL	Fmc-DP-WindowsNT
OS/390(6)	Indicates that the program is an OS/390 program.	
	C	Fmc_DP_OS390
	C++	FmcjImplementationData::OS390
	Java	Basis.OS390
	COBOL	Fmc-DP-OS390
Solaris(7)	Indicates that the program is a Solaris program.	
	C	Fmc_DP_Solaris
	C++	FmcjImplementationData::Solaris
	Java	Basis.SOLARIS
	COBOL	Fmc-DP-SOLARIS

- FmcjImplementationDataType/ com.ibm.workflow.api.ProgramDataPackage.Type — FmcjImplementationData::Type/

NotSet(0)	Indicates that nothing is known about the implementation.	
	C	Fmc_DT_NotSet
	C++	FmcjImplementationData::NotSet
	Java	ImplementationData.NOT_SET

COBOL Fmc-DT-NotSet

EXE(1) Indicates that the program is an executable.

C Fmc_DT_EXE

C++ FmcjImplementationData::EXE

Java ImplementationData.EXE

COBOL Fmc-DT-EXE

DLL(2) Indicates that the program is implemented by a dynamic link library.

C Fmc_DT_DLL

C++ FmcjImplementationData::DLL

Java ImplementationData.DLL

COBOL Fmc-DT-DLL

External Indicates that the program is some external service.

C(4) Fmc_DT_External

C++(4) FmcjImplementationData::External

Java(3) ImplementationData.EXTERNAL

COBOL(4) Fmc-DT-External

- FmcjItemType/ FmcjItem::ItemType/ com.ibm.workflow.api.ItemPackage.ItemType

NotSet(0) Indicates that nothing is known about the item type.

C Fmc_IT_NotSet

C++ FmcjItem::unknown

Java ItemType.UNKNOWN

COBOL Fmc-IT-NotSet

Workitem(1) Indicates that the item is a work item.

C Fmc_IT_Workitem

C++ FmcjItem::Workitem

Java ItemType.WORK_ITEM

COBOL Fmc-IT-Workitem

ProcessInstanceNotification
Indicates that the item is a process instance notification.

C(3) Fmc_IT_ProcessInstanceNotification

C++(3) FmcjItem::ProcessInstanceNotification

Java(2) ItemType.PROCESS_INSTANCE_NOTIFICATION

COBOL(3) Fmc-IT-ProcInstNotif

FirstActivityInstanceNotification
Indicates that the item is the first activity instance notification.

C(4) Fmc_IT_FirstActivityInstanceNotification

C++(4) FmcjItem::FirstActivityInstanceNotification

Java(3) ItemType.FIRST_ACTIVITY_INSTANCE_NOTIFICATION

COBOL(4) Fmc-IT-FirstActInstNotif

SecondActivityInstanceNotification
Indicates that the item is the second activity instance notification.

C(5) Fmc_IT_SecondActivityInstanceNotification

C++(5) FmcjItem::SecondActivityInstanceNotification

Java(4) ItemType.SECOND_ACTIVITY_INSTANCE_NOTIFICATION

COBOL(5) Fmc-IT-SecActInstNotif

- FmcjProcessInstanceEscalation/ FmcjProcessInstance::Escalation/ com.ibm.workflow.api.ProcessInstancePackage.Escalation

NotSet(0) Indicates that it is not known whether there is a notification on the process instance.

C Fmc_PE_NotSet

C++ FmcjProcessInstance::NotSet

Java Escalation.NOT_SET

COBOL Fmc-PE-NotSet

NoNotification(1)
Indicates that no notification occurred so far on the process instance.

C Fmc_PE_NoNotification

C++ FmcjProcessInstance::NoNotification

Java Escalation.NO_NOTIFICATION

COBOL Fmc-PE-NoNotif

ProcessInstanceNotification
Indicates that a process instance notification occurred.

C(3) Fmc_PE_ProcessNotification

C++(3) FmcjProcessInstance::ProcessNotification

Java(2) Escalation.PROCESS_NOTIFICATION

COBOL(3) Fmc-PE-ProcNotif

- FmcjProcessInstanceStateValue/ FmcjProcessInstance::state/ com.ibm.workflow.api.ProcessInstancePackage.ExecutionState

NotSet(0) Indicates that nothing is known about the state of the process instance.

C Fmc_PS_NotSet

C++ FmcjProcessInstance::undefined

Java ExecutionState.UNDEFINED

COBOL Fmc-PS-NotSet

Ready(1) Indicates that the process instance is in the ready state.

C Fmc_PS_Ready

	C++	FmcjProcessInstance::ready
	Java	ExecutionState.READY
	COBOL	Fmc-PS-Ready
Running(2)	Indicates that the process instance is in the running state.	
	C	Fmc_PS_Running
	C++	FmcjProcessInstance::running
	Java	ExecutionState.RUNNING
	COBOL	Fmc-PS-Running
Finished	Indicates that the process instance is in the finished state.	
	C(4)	Fmc_PS_Finished
	C++(4)	FmcjProcessInstance::finished
	Java(3)	ExecutionState.FINISHED
	COBOL(4)	Fmc-PS-Finished
Terminated	Indicates that the process instance is in the terminated state.	
	C(8)	Fmc_PS_Terminated
	C++(8)	FmcjProcessInstance::terminated
	Java(4)	ExecutionState.TERMINATED
	COBOL(8)	Fmc-PS-Term
Suspended	Indicates that the process instance is in the suspended state.	
	C(16)	Fmc_PS_Suspended
	C++(16)	FmcjProcessInstance::suspended
	Java(5)	ExecutionState.SUSPENDED
	COBOL(16)	Fmc-PS-Suspended
Terminating	Indicates that the process instance is in the terminating state.	
	C(32)	Fmc_PS_Terminating
	C++(32)	FmcjProcessInstance::terminating
	Java(6)	ExecutionState.TERMINATING
	COBOL(32)	Fmc-PS-Terminating
Suspending	Indicates that the process instance is in the suspending state.	
	C(64)	Fmc_PS_Suspending
	C++(64)	FmcjProcessInstance::suspending
	Java(7)	ExecutionState.SUSPENDING
	COBOL(64)	Fmc-PS-Suspending
Deleted	Indicates that the process instance is in the deleted state.	
	C(128)	Fmc_PS_Deleted
	C++(128)	FmcjProcessInstance::deleted
	Java(8)	ExecutionState.DELETED

COBOL(128) Fmc-PS-Deleted

- State/ FmcjItemStateValue/ FmcjItem::state/ com.ibm.workflow.api.ItemPackage.ExecutionState

NotSet(0) Indicates that nothing is known about the state of the item.

C Fmc_IS_NotSet

C++ FmcjItem::undefined

Java ExecutionState.UNDEFINED

COBOL Fmc-IS-NotSet

Ready(1) Indicates that the item is in the ready state.

C Fmc_IS_Ready

C++ FmcjItem::ready

Java ExecutionState.READY

COBOL Fmc-IS-Ready

Running(2) Indicates that the item is in the running state.

C Fmc_IS_Running

C++ FmcjItem::running

Java ExecutionState.RUNNING

COBOL Fmc-IS-Running

Finished Indicates that the item is in the finished state.

C(4) Fmc_IS_Finished

C++(4) FmcjItem::finished

Java(3) ExecutionState.FINISHED

COBOL(4) Fmc-IS-Finished

Terminated Indicates that the item is in the terminated state.

C(8) Fmc_IS_Terminated

C++(8) FmcjItem::terminated

Java(4) ExecutionState.TERMINATED

COBOL(8) Fmc-IS-Term

Suspended Indicates that the item is in the suspended state.

C(16) Fmc_IS_Suspended

C++(16) FmcjItem::suspended

Java(5) ExecutionState.SUSPENDED

COBOL(16) Fmc-IS-Suspended

Disabled Indicates that the item is disabled.

C(32) Fmc_IS_Disabled

C++(32) FmcjItem::disabled

Java(6) ExecutionState.DISABLED

COBOL(32) Fmc-IS-Disabled

CheckedOut	Indicates that the item is checked out.	
	C(64)	Fmc_IS_CheckedOut
	C++(64)	FmcjItem::checkedOut
	Java(7)	ExecutionState.CHECKED_OUT
	COBOL(64)	Fmc-IS-CheckedOut
InError	Indicates that the item is in the InError state.	
	C(128)	Fmc_IS_InError
	C++(128)	FmcjItem::inError
	Java(8)	ExecutionState.IN_ERROR
	COBOL(128)	Fmc-IS-InError
Executed	Indicates that the item has been executed.	
	C(256)	Fmc_IS_Executed
	C++(256)	FmcjItem::Executed
	Java(9)	ExecutionState.EXECUTED
	COBOL(256)	Fmc-IS-Executed
Planning	Indicates that the item is in the planning state.	
	C(512)	Fmc_IS_Planning
	C++(512)	FmcjItem::Planning
	Java(10)	ExecutionState.PLANNING
	COBOL(512)	Fmc-IS-Planning
ForceFinished	Indicates that the item has been force-finished.	
	C(1024)	Fmc_IS_ForceFinished
	C++(1024)	FmcjItem::ForceFinished
	Java(11)	ExecutionState.FORCE_FINISHED
	COBOL(1024)	Fmc-IS-ForceFinished
Deleted	Indicates that the item has been deleted.	
	C(4096)	Fmc_IS_Deleted
	C++(4096)	FmcjItem::Deleted
	Java(12)	ExecutionState.DELETED
	COBOL(4096)	Fmc-IS-Deleted
Terminating	Indicates that the item is in the terminating state.	
	C(8192)	Fmc_IS_Terminating
	C++(8192)	FmcjItem::Terminating
	Java(13)	ExecutionState.TERMINATING
	COBOL(8192)	Fmc-IS-Terminating
Suspending	Indicates that the item is in the suspending state.	
	C(16384)	Fmc_IS_Suspending

C++(16384) FmcjItem::Suspending

Java(14) ExecutionState.SUSPENDING

COBOL(16384)
Fmc-IS-Suspending

- FmcjWorkitemProgramRetrieval/ FmcjWorkitem::ProgramRetrieval/ com.ibm.workflow.api.WorkItemPackage.ProgramRetrieval

  NotSet(0) Indicates that nothing is said about which program definitions to retrieve.

  C Fmc_WS_NotSet

  C++ FmcjWorkitem::NotSet

  Java ProgramRetrieval.NOT_SET

  COBOL Fmc-WS-NotSet

  CommonDataOnly(1)
  Indicates that the common parts of program definitions are to be retrieved.

  C Fmc_WS_CommonDataOnly

  C++ FmcjWorkitem::CommonDataOnly

  Java ProgramRetrieval.COMMON_DATA_ONLY

  COBOL Fmc-WS-CommonDataOnly

  SpecifiedDefinitions(2)
  Indicates that the specified program definitions are to be retrieved.

  C Fmc_WS_SpecifiedDefinitions

  C++ FmcjWorkitem::SpecifiedDefinitions

  Java ProgramRetrieval.SPECIFIED_DEFINITIONS

  COBOL Fmc-WS-SpecifiedDefs

  AllDefinitions
  Indicates that all program definitions are to be retrieved.

  C(4) Fmc_WS_AllDefinitions

  C++(4) FmcjWorkitem::AllDefinitions

  Java(3) ProgramRetrieval.ALL_DEFINITIONS

  COBOL(4) Fmc-WS-AllDefs

- FmcjPersistentListTypeOfList/ FmcjPersistentList::TypeOfList/ com.ibm.workflow.api.PersistentListPackage.TypeOfList

  NotSet(0) Indicates that nothing is known about the list type.

  C Fmc_LT_NotSet

  C++ FmcjPersistentList::NotSet

  Java TypeOfList.NOT_SET

  COBOL Fmc-LT-NotSet

  Public(1) Indicates that the list definition is for public usage.

  C Fmc_LT_Public

	C++	FmcjPersistentList::Public
	Java	TypeOfList.PUBLIC
	COBOL	Fmc-LT-Public
Private	Indicates that the list definition is for private usage.	
	C(3)	Fmc_LT_Private
	C++(3)	FmcjPersistentList::Private
	Java(2)	TypeOfList.PRIVATE
	COBOL(3)	Fmc-LT-Private

Accessing a value of type integer

Returns the value of a property of type *long*, *unsigned long*, or *int*. Zero (0) is returned if no information is available. The following examples illustrate return of a *long* value.

C

```
long FMC_APIENTRY FmcjXxxProperty( FmcjXxxHandle handle )

unsigned long FMC_APIENTRY FmcjXxxProperty( FmcjXxxHandle handle )
```

C++

```
long Property() const

unsigned long Property() const
```

Java

```
public abstract int property() throws FmcException
```

COBOL

```
      FmcjXxxProperty.
           CALL    "FmcjXxxProperty"
                          USING
                          BY VALUE
                             handle
                          RETURNING
                             longReturnValue.
```

Parameters

handle Input. The handle of the object to be queried.

Return type

long/unsigned long/int

The property value.

Declaration examples

C unsigned long FMC_APIENTRY FmcjWorkitemPriority(FmcjWorkitemHandle handle);

C++ unsigned long Priority() const;

Java public abstract int priority() throws FmcException;

Accessing a value of type string

Returns the value of a property of type *string*. An empty string or buffer is returned if no information is available.

C

```
char * FMC_APIENTRY FmcjXxxProperty(  FmcjXxxHandle  handle,
                                      char *         buffer,
                                      unsigned long  bufferLength )
```

C++

```
string Property() const
```

Java

```
public abstract String property() throws FmcException
```

COBOL

```
       FmcjXxxProperty.
            CALL    "FmcjXxxProperty"
                           USING
                           BY VALUE
                              handle
                              buffer
                              bufferLength
                           RETURNING
                              pointerReturnValue.
```

Parameters

handle Input. The handle of the object to be queried.

buffer Input/Output. A pointer to a buffer to contain the property value.

bufferLength Input. The length of the buffer; must be big enough to hold the largest possible value (see file fmcmxcon.h for the minimum required lengths). You can use a single buffer for retrieving all your character values.

Return type

char*/string/String

The property value.

Declaration examples

C char* FMC_APIENTRY FmcjWorkitemDescription(FmcjWorkitemHandle handle);

C++ string Description() const;

Java public abstract String Description() throws FmcException;

Accessing a multi-valued property

Returns the value of a multi-valued property by providing a collection of values. The collection is represented as a vector in C, C++, and COBOL, and as an array in Java. In C++, the collection object to be filled has to be provided by the caller. Use the appropriate accessor API calls to read a single value (refer to "C and COBOL vector accessor functions" on page 21).

An unchanged vector or an empty array is returned if no information is available.

Any existing array elements are overwritten. Vector elements in C++ are, however, appended to the supplied vector. If you want to read the current values only, you have to erase all elements of the vector.

C

```
FmcjYyyVectorHandle
FMC_APIENTRY FmcjXxxProperty( FmcjXxxHandle handle )
```

C++

```
void Property( vector<ValueType> & value ) const
```

Java

```
public abstract ValueType[] property() throws FmcException
```

COBOL

```
      FmcjXxxProperty.
           CALL    "FmcjXxxProperty"
                         USING
                         BY VALUE
                            handle
                         RETURNING
                            FmcjYyyVectorHandleReturnValue.
```

Parameters

handle Input. The handle of the object to be queried.
value Input/Output. The vector or array to contain the values of the property.

Return type

FmcjValueTypeVectorHandle/ValueType[]
The vector or array of values of the property.

Declaration examples

C	FmcjStringVectorHandle FMC_APIENTRY FmcjWorkitemStaff(FmcjWorkitemHandle handle);
C++	void Staff(vector<string> & staff) const;
Java	public abstract String[] staff() throws FmcException;

Accessing an object valued property

Returns the value of a property which is itself described by an object.

C

```
FmcjObjectHandle
FMC_APIENTRY FmcjXxxProperty( FmcjXxxHandle handle )
```

C++

```
FmcjObject Property() const
```

Java

```
public abstract Object property() throws FmcException

public abstract ExecutionService
locate( String systemGroup, String system) throws FmcException

public abstract
ExecutionAgent getExecutionAgent() throws FmcException
```

COBOL

```
      FmcjXxxProperty.
           CALL    "FmcjXxxProperty"
                          USING
                          BY VALUE
                             handle
                          RETURNING
                             FmcjObjectHandleReturnValue.
```

Parameters

handle Input. The handle of the object to be queried.

system Input. The system where the execution server runs.

systemGroup
Input. The system group where the execution server runs.

Return type

ExecutionAgent
The program execution agent which provides for the context of an activity implementation.

ExecutionService
The execution service which provides for the interface to the execution server.

Object/Handle/FmcjObject
The property value.

Declaration examples

C	FmcjErrorHandle FMC_APIENTRY FmcjWorkitemErrorReason(FmcjWorkitemHandle handle);
C++	FmcjError ErrorReason() const;
Java	public abstract FmcError errorReason() throws FmcException;

Accessing a pointer valued property

Returns the value of a property which is a pointer to some object.

C

```
FmcjObjectHandle
FMC_APIENTRY FmcjXxxProperty( FmcjXxxHandle handle )
```

C++

```
FmcjObject * Property() const
```

Java

```
public abstract Object property() throws FmcException
```

COBOL

```
      FmcjXxxProperty.
           CALL    "FmcjXxxProperty"
                          USING
                          BY VALUE
                             handle
                          RETURNING
                             FmcjObjectHandleReturnValue.
```

Parameters

handle Input. The handle of the object to be queried.

Return type

Object*/Handle/FmcjObject*

A pointer or handle to the object or the object itself.

Declaration examples

C	FmcjReadOnlyContainerHandle FMC_APIENTRY FmcjProgramDataInContainer(FmcjProgramDataHandle handle);
C++	FmcjReadOnlyContainer* InContainer() const;
Java	public abstract ReadOnlyContainer inContainer() throws FmcException;

Determining whether an optional property is set

This API call states whether an optional property is set.

When the property is a secondary property and the object queried is not yet completely read, it is unknown whether the property is set or not so that a default value of true is returned.

Note: Java does not expose IsNull() methods since it is able to return null objects.

C

```
bool FMC_APIENTRY FmcjXxxPropertyIsNull( FmcjXxxHandle handle )
```

C++

```
bool PropertyIsNull() const
```

COBOL

```
      FmcjXxxPropertyIsNull.
           CALL    "FmcjXxxPropertyIsNull"
                          USING
                          BY VALUE
                             handle
                          RETURNING
                             boolReturnValue.
```

Parameters

handle Input. The handle of the object to be queried.

Return type

bool/boolean True if the property is not set, otherwise false.

Declaration examples

C bool FMC_APIENTRY FmcjWorkitemDescriptionIsNull(FmcjWorkitemHandle handle);

C++ bool DescriptionIsNull() const;

Setting a value of type integer

This API call sets the specified property to the specified value.

C

```
void FMC_APIENTRY FmcjXxxSetProperty( FmcjXxxHandle  handle,
                                      long           newValue );
```

C++

```
void SetProperty( long newValue );
```

Java

```
public abstract void setProperty( int newValue ) throws FmcException
```

COBOL

```
FmcjXxxSetProperty.
     CALL    "FmcjXxxSetProperty"
                    USING
                    BY VALUE
                       handle
                       newValue.
```

Parameters

handle Input. The handle of the object to be queried.
newValue Input. The new value of the property.

Declaration examples

C void FMC_APIENTRY FmcjExecutionServiceSetTimeout(FmcjExecutionServiceHandle handle, long newValue);

C++ void SetTimeout(long newValue) const;

Java public abstract void SetTimeout(int newValue) throws FmcException;

An example is the FmcjService::SetTimeout API call which sets the timeout value for requests issued by the client to an MQSeries Workflow server via this FmcjService object. In other words, it sets the time the client is willing to wait for an answer.

When set, the new timeout value is used for all API calls requiring communication between the client and the server. It can be set (changed) as often as desired. It is to be provided as milliseconds. A negative value is interpreted as -1, that is, an indefinite timeout.

The default timeout value is taken from the user's profile, from the APITimeOut value; if not found, from the configuration profile. If it is also not found there, the default is 180000 ms (3 minutes).

Note: It is possible that, even though FMC_ERROR_TIMEOUT is returned when you issue a client-server call, the MQSeries Workflow server has successfully processed the request. However, the server could not send back FMC_OK because communication reported a timeout in the meantime. If the request has not been processed, increase the value set for the timeout and retry the call.

Setting an object valued property

This API call sets the specified property for the specified object.

Java

```
public abstract void addProperty( Object value )

public abstract
void setContext( String args[], Properties properties )

public abstract
void setContext( Applet applet, Properties properties )
```

Parameters

applet Input. The applet which instantiated the agent. If IIOP is used as the communication protocol, this information is required.

args Input. The command line arguments passed to the application which instantiated the agent bean.

properties Input. The environmental properties passed to the application or applet when it was instantiated.

value Input. The value of the property.

Declaration examples

Java public abstract void addPropertyChangeListener(PropertyChangeListener value);

Updating an object

This API call updates the specified object with information sent from an MQSeries Workflow server. The update information must have been provided for the specified object.

The server pushes update information for work items (as long as they are not disabled), activity instance notifications, and process instance notifications. The process setting of the associated process instance must specify REFRESH_POLICY PUSH for that process instance itself or as a process default. Logon must have been performed with a present session mode.

C

```
APIRET FMC_APIENTRY FmcjXxxUpdate( FmcjXxxHandle           handle,
                                   FmcjExecutionDataHandle data );
```

C++

```
APIRET Update( FmcjExecutionData const & data );
```

COBOL

```
      FmcjXxxUpdate.
           CALL    "FmcjXxxUpdate"
                         USING
                         BY VALUE
                            handle
                            dataValue
                         RETURNING
                            intReturnValue.
```

Parameters

handle Input. The handle of the object to be updated.

data/dataValue Input. The data which is to be used for the update.

Return codes

The C and COBOL calls and the MQSeries Workflow result object can return the following codes; the number in parentheses shows their integer value:

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is expected, but 0 is passed.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, it does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is invalid; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_INVALID_OID(805)
The execution data is no data to update the specified object; it does not belong to the specified object.

FMC_ERROR_WRONG_KIND(501)
The execution data is no data to update the specified object; it is no update data.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

C example: accessing values

```
#include <stdio.h>
#include <fmcjcrun.h>
int main()
{
  APIRET                       rc;
  FmcjExecutionServiceHandle   service   = 0;
  FmcjWorkitemHandle           workitem  = 0;
  FmcjStringVectorHandle       sList     = 0;
  char                         category[FMC_CATEGORY_NAME_LENGTH+1];
  char                         generalBuffer[200];
  unsigned long                priority  = 0;
  int                          enumValue = 0;
  FmcjCDateTime                startTime;
  unsigned long                i         = 0;

 FmcjGlobalConnect();

  /* logon */
  FmcjExecutionServiceAllocate(&service);
  rc = FmcjExecutionServiceLogon( service,
                                  "USERID", "password",
                                  Fmc_SM_Default, Fmc_SA_Reset
                                );
                                       /* set the timeout for requests */
  FmcjExecutionServiceSetTimeout( service, 60000 );

 /* assumption: workitem has been queried from the server             */
                                       /* access a value of type bool  */
  if ( FmcjWorkitemCategoryIsNull( workitem ) )
    printf( "Category is not set\n" );
  else                                 /* access a value of type char  */
  {                                    /* use a buffer which fits      */
    FmcjWorkitemCategory( workitem, category, FMC_CATEGORY_NAME_LENGTH+1 );
    printf( "Category   : %s\n", category );
  }
                                       /* access a date/time value     */
  startTime= FmcjWorkitemStartTime( workitem );
  printf( "Start time : %s\n",
    FmcjDateTimeAsString(&startTime, generalBuffer, 200) );
                                       /* access a value of type long  */
  priority = FmcjWorkitemPriority( workitem );
  printf( "Priority   : %u\n", priority );
                                      /* access an enumerated value   */
  enumValue= FmcjWorkitemReceivedAs( workitem );
  if ( enumValue == Fmc_IR_Normal )
    printf( "Received as: %s\n","qualified user" );
  ...
                                       /* access a multi-valued field  */
   sList= FmcjWorkitemSupportTools( workitem );
   printf( "Support tools: " );
   for( i=0; i< FmcjStringVectorSize(sList); i++ )
   {                                   /* use a large buffer           */
     printf("%s ", FmcjStringVectorNextElement(sList, generalBuffer, 200) );
   }
  /* logoff */
  FmcjExecutionServiceLogoff(service);
  FmcjExecutionServiceDeallocate(&service);
  FmcjGlobalDisconnect();
  return FMC_OK;
}
```

Figure 21. Accessing values in C

C++ example: accessing values

```
#include <iomanip.h>
#include <bool.h>
#include <vector.h>
#include <fmcjstr.hxx>
#include <fmcjprun.hxx>
int main()
{
  FmcjGlobal::Connect();
   // logon
  FmcjExecutionService service;   APIRET rc = service.Logon("USERID", "password");
                                        // set the timeout for requests
  service.SetTimeout( 60000 );
  // assumption: workitem has been queried from the server
                                        // access a value of type bool
  if ( workitem.CategoryIsNull() )
    cout << "Category is not set" << endl;
  else                                  // access a value of type char
  {                                     // use a buffer which fits
    cout << "Category   : " << workitem.Category()<< endl;
  }
                                        // access a value of type date/time
  cout << "Start time : " << workitem.StartTime()<< endl;
                                      // access a value of type long
  cout << "Priority   : " << workitem.Priority()<< endl;
                                        // access an enumerated value
  FmcjItem::AssignReason reason= workitem.ReceivedAs();
  cout << "Received as: " <<
          ((reason == FmcjItem::Normal) ? "normal user" : "...")
       << endl;
  vector<string> tools; int j;          // access a multi-valued field
  workitem.SupportTools( tools );
  cout << "Support tools: " ;
  while ( j < tools.size() )
    cout << tools[j++] << " ";
   // logoff
  rc = service.Logoff();
   FmcjGlobal::Disconnect();
  return FMC_OK;
}                                       // destructors called automatically
```

Figure 22. Accessing values in C++

COBOL example: accessing values

```
 IDENTIFICATION DIVISION.
 PROGRAM-ID. "VALUES".

 DATA DIVISION.

   WORKING-STORAGE SECTION.

   COPY fmcvars.
   COPY fmcconst.
   COPY fmcrcs.

   01 localUserID   PIC X(30) VALUE z"USERID".
   01 localPassword PIC X(30) VALUE z"PASSWORD".
   01 categBuffer   PIC X(34).
   01 generalBuffer PIC X(200).
   01 i             PIC 9(9) BINARY VALUE 0.

   LINKAGE SECTION.

   01 retCode            PIC S9(9) BINARY.

 PROCEDURE DIVISION USING retCode.

       PERFORM FmcjGlobalConnect.
* logon
       PERFORM FmcjESAllocate.

       CALL "SETADDR" USING localUserId userId.
       CALL "SETADDR" USING localPassword passwordValue.
       MOVE Fmc-SM-Default TO sessionMode.
       MOVE Fmc-SA-Reset TO absenceIndicator.
       PERFORM FmcjESLogon.
* set the timeout for requests
       MOVE 60000 TO newTimeOutValue.
       PERFORM FmcjESSetTimeout.

* assumption: workitem has been queried from the server
* and hdlItem points to this workitem

* access a value of type bool (PIC 9 BINARY)
       PERFORM FmcjWICategIsNull.
       IF boolReturnValue = 1
          DISPLAY "Category is not set"
       ELSE
* access a value of type char (POINTER to a PIC X(n))
*         use a buffer which fits
          CALL "SETADDR" USING categBuffer categoryNameBuffer
          MOVE FMC-CATEG-NAME-LENGTH TO bufferLength
          PERFORM FmcjWICateg
          DISPLAY "Category   : " categBuffer
       END-IF
* access a date/time value
       PERFORM FmcjWIStartTime.
       MOVE dateTimeReturnValue TO timeValue.
       CALL "SETADDR" USING generalBuffer dateTimeBuffer.
       MOVE 200 TO bufferLength.
       PERFORM FmcjDateTimeAsString.
       DISPLAY "Start time : " generalBuffer.
* access a value of type unsigned long (PIC 9(9) BINARY)
       SET hdlWorkitem TO hdlItem.
       PERFORM FmcjWIPriority.
       DISPLAY "Priority   : " ulongReturnValue.
```

Figure 23. Accessing values in COBOL (via PERFORM) (Part 1 of 2)

```
   * access an enumerated value (PIC S9(9) BINARY)
      PERFORM FmcjWIReceivedAs.
      IF intReturnValue = Fmc-IR-Normal
      DISPLAY "Received as: qualified user"
      END-IF
* access a multi-valued field
      PERFORM FmcjWISupportTools.
      SET hdlVector TO FmcjStrVHandleReturnValue.
      PERFORM FmcjStrVSize.
      DISPLAY "Support tools: ".
*     use a large buffer
      CALL "SETADDR" USING generalBuffer elementBuffer
      PERFORM VARYING i FROM 0 BY 1 UNTIL i >= ulongReturnValue
         PERFORM FmcjStrVNextElement
         DISPLAY generalBuffer
      END-PERFORM
* logoff
      PERFORM FmcjESLogoff.
      DISPLAY "Logged off".
      PERFORM FmcjESDeallocate.
      PERFORM FmcjGlobalDisconnect.
      MOVE FMC-OK TO retCode.
      GOBACK.

      COPY fmcperf.
```

Figure 23. Accessing values in COBOL (via PERFORM) (Part 2 of 2)

```
 IDENTIFICATION DIVISION.
 PROGRAM-ID. "VALUES".

 DATA DIVISION.

   WORKING-STORAGE SECTION.

   COPY fmcvars.
   COPY fmcconst.
   COPY fmcrcs.

   01 localUserID   PIC X(30) VALUE z"USERID".
   01 localPassword PIC X(30) VALUE z"PASSWORD".
   01 categBuffer   PIC X(34).
   01 generalBuffer PIC X(200).
   01 i             PIC 9(9) BINARY VALUE 0.

   LINKAGE SECTION.

   01 retCode            PIC S9(9) BINARY.

 PROCEDURE DIVISION USING retCode.

      CALL "FmcjGlobalConnect".
* logon
      CALL "FmcjExecutionServiceAllocate"
         USING BY REFERENCE serviceValue
         RETURNING intReturnValue.

      CALL "SETADDR" USING localUserId userId.
      CALL "SETADDR" USING localPassword passwordValue.
      CALL "FmcjExecutionServiceLogon"
         USING BY VALUE serviceValue
                        userID
                        passwordValue
                        Fmc-SM-Default
                        Fmc-SA-Reset
         RETURNING intReturnValue.

* set the timeout for requests
      MOVE 60000 TO newTimeOutValue.
      CALL "FmcjServiceSetTimeout"
         USING BY VALUE serviceValue
                        newTimeoutValue.

* assumption: workitem has been queried from the server
* and hdlItem points to this workitem

* access a value of type bool (PIC 9 BINARY)
      CALL "FmcjItemCategoryIsNull"
         USING BY VALUE hdlItem
         RETURNING boolReturnValue.
      IF boolReturnValue = 1
         DISPLAY "Category is not set"
      ELSE
* access a value of type char (POINTER to a PIC X(n))
*        use a buffer which fits
         CALL "SETADDR" USING categBuffer categoryNameBuffer
         MOVE FMC-CATEG-NAME-LENGTH TO bufferLength
         CALL "FmcjItemCategory"
```

Figure 24. Accessing values in COBOL (via CALL) (Part 1 of 3)

```
            USING BY VALUE hdlItem
                           categoryNameBuffer
                           bufferLength
            RETURNING pointerReturnValue
         DISPLAY "Category   : " categBuffer
      END-IF

* access a date/time value
      CALL "FmcjItemStartTime"
         USING BY VALUE hdlItem
         RETURNING dateTimeReturnValue.
      CALL "SETADDR" USING generalBuffer dateTimeBuffer.
      MOVE 200 TO bufferLength.
      CALL "FmcjDateTimeAsString"
         USING BY REFERENCE dateTimeReturnValue
               BY VALUE     dateTimeBuffer
                            bufferLength
         RETURNING pointerReturnValue.
      DISPLAY "Start time : " generalBuffer.
* access a value of type unsigned long (PIC 9(9) BINARY)
      SET hdlWorkitem TO hdlItem.
      CALL "FmcjWorkitemPriority"
         USING BY VALUE hdlItem
         RETURNING ulongReturnValue.
      DISPLAY "Priority   : " ulongReturnValue.
* access an enumerated value (PIC S9(9) BINARY)
      CALL "FmcjItemReceivedAs"
         USING BY VALUE hdlItem
         RETURNING intReturnValue.
       IF intReturnValue = Fmc-IR-Normal
         DISPLAY "Received as: qualified user"
      END-IF
* access a multi-valued field
      CALL "FmcjWorkitemSupportTools"
         USING BY VALUE hdlItem
         RETURNING FmcjStrVHandleReturnValue.
      SET hdlVector TO FmcjStrVHandleReturnValue.
      CALL "FmcjStringVectorSize"
         USING BY VALUE hdlVector
         RETURNING ulongReturnValue.
      DISPLAY "Support tools: ".
*     use a large buffer
      CALL "SETADDR" USING generalBuffer elementBuffer
      PERFORM VARYING i FROM 0 BY 1 UNTIL i >= ulongReturnValue
      CALL "FmcjStringVectorNextElement"
         USING BY VALUE hdlVector
                        elementBuffer
                        bufferLength
         RETURNING pointerReturnValue
         DISPLAY generalBuffer
      END-PERFORM
* logoff
      CALL "FmcjExecutionServiceLogoff"
         USING BY VALUE serviceValue
         RETURNING intReturnValue.
      DISPLAY "Logged off".
      CALL "FmcjExecutionServiceDeallocate"
         USING BY REFERENCE serviceValue
         RETURNING intReturnValue.
      CALL "FmcjGlobalDisconnect".
```

Figure 24. Accessing values in COBOL (via CALL) (Part 2 of 3)

```
MOVE FMC-OK TO retCode.
GOBACK.
```

Figure 24. Accessing values in COBOL (via CALL) (Part 3 of 3)

Action API calls

Action API calls are client-server calls involving communication with an MQSeries Workflow server. As such, they require the client to be logged on.

Action API calls can be issued on service objects and on transient objects representing persistent ones. These objects remember the context of a user session so that a communication path to an MQSeries Workflow server can be established. As a consequence, empty objects cannot be used in order to issue action calls.

Action API calls are either synchronous requests waiting for the server's reply, asynchronous requests expecting the server's reply at some other point in time, or API calls receiving information from an MQSeries Workflow server.

All action API calls are described separately in "Chapter 5. API action and activity implementation calls" on page 287. You can find examples in "Chapter 6. Examples" on page 525.

Activity implementation API calls

An activity can be implemented by a program which uses the MQSeries Workflow API. In this case, the activity implementation API calls provide access to the input and output containers of the activity instance or work item. They also allow the program implementing an activity to return the updated output container to MQSeries Workflow so that navigation can continue on the basis of those values.

A program implementing an activity is usually executed under the control of an MQSeries Workflow program execution server on request from an MQSeries Workflow execution server. When an MQSeries Workflow execution server receives a request to start a work item, it determines the implementing program to be started and sends an appropriate request together with the input and output containers, if needed, to the program execution server or the logged-on user's program execution agent. Since containers are sent to the program execution server, input and output containers are requested from and passed to an MQSeries Workflow program execution server by the implementing program. You do *not* have to create an execution service object and log on to an MQSeries Workflow execution server to handle containers from within an activity implementation.

However, if you want not only to access containers but also to query information about the process instance the work item is a part of, you have to log on to the MQSeries Workflow execution server that requested that your program be started. You can use the Passthrough() API call of the execution service to begin a session with the execution server from within the activity implementation program or support tool. In this way, you can use the environment of the work item, that is, you do not need any other user ID, password, system group, or system information.

If the activity implementation does not handle all work by itself but distributes work by starting subprograms that run as separate operating system processes, and

when those subprograms request containers, then the program execution server cannot know which is the calling program. For that purpose, the program calling the program execution server must provide the program identification of the actual activity implementation, that is, it must use the *remote* container or passthrough calls. This requires that the activity implementation has retrieved its program identification and passed it to the started program. Note that the program execution server only provides the program identification to *trusted* programs.

Chapter 2. Language interfaces

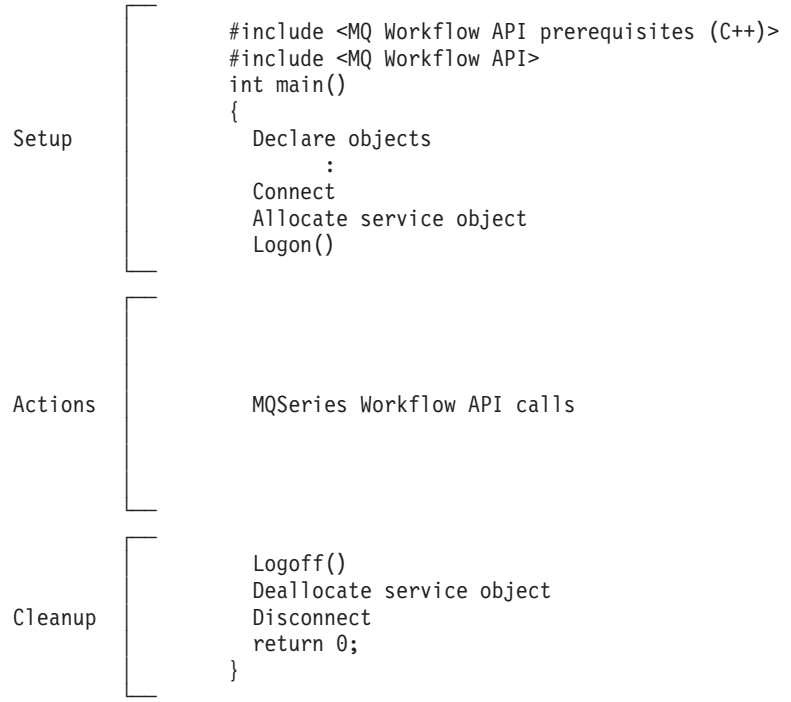
This chapter discusses language-specific considerations for using the API. It also describes the XML message interface in detail.

C and C++ interface

This section provides an overview of the concepts which are specific to the MQSeries Workflow C and C++ APIs.

Coding an MQSeries Workflow client application in C or C++

An MQSeries Workflow C or C++ client application typically contains the following parts (which may not be delimited this clearly, however):



To set up your program, you typically declare the program variables or objects you are going to use and you include the MQSeries Workflow API header files you need for your actions. When using the C++ API, definitions of *bool*, *string*, and *vector* are needed. Include the respective files before the MQSeries Workflow API headers.

You should then initialize the MQSeries Workflow API by calling Connect() so that resources held by the API are allocated correctly. Connect() and Disconnect() are to be called at the beginning and end of each thread, respectively.

You then need to allocate a service object which represents the server you are going to ask services from. Once the service object is allocated, you can log on. Logon establishes a session between the user logging on and the server represented by your service object. All subsequent calls requiring client/server communication run through this session.

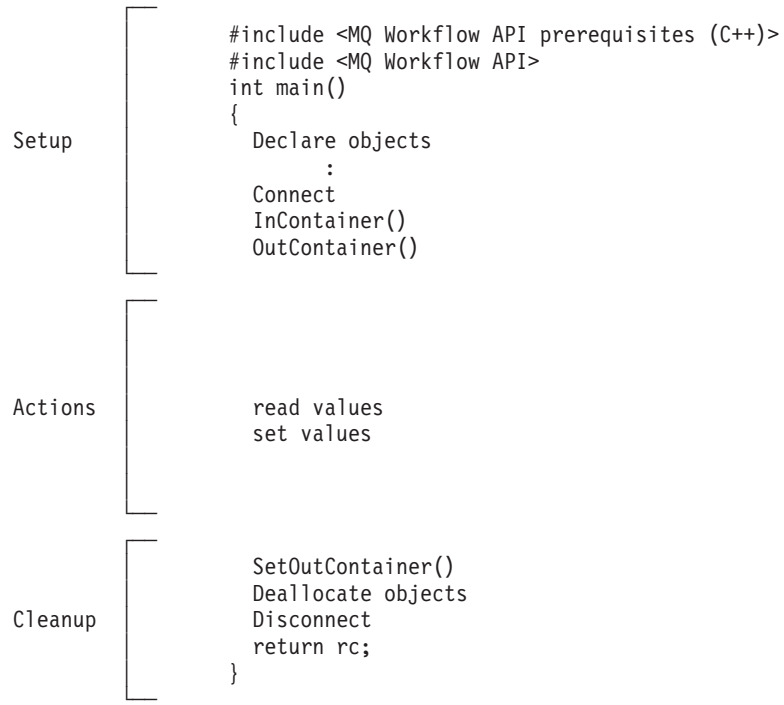
After a successful logon, you can issue action or program execution management API calls in order to query or manage MQSeries Workflow objects you are authorized for.

At the end of your program, you log off in order to close the session to the server and you deallocate any resources held by your program, especially the service object.

As a last step, you disconnect from the MQSeries Workflow API so that resources held by the API are deallocated correctly.

Coding an MQSeries Workflow activity implementation in C or C++

An MQSeries Workflow C or C++ activity implementation typically contains the following parts:



To set up your program, you typically declare the program variables or objects you are going to use and you include the MQSeries Workflow API header files you need for your actions. When using the C++ API, definitions of *bool*, *string*, and *vector* are needed. Include the respective files before the MQSeries Workflow API headers.

You should then initialize the MQSeries Workflow API by calling Connect() so that resources held by the API are allocated correctly. Connect() and Disconnect() are to be called at the beginning and end of each thread, respectively.

On platforms other than OS/390, an activity implementation can then retrieve the activity's input and output containers from the MQSeries Workflow program execution agent that started this program. On OS/390, the activity implementation in CICS or IMS gets input and output containers when it is started by the PES.

Having access to the containers, you can read and set values according to your programming logic.

At the end of your program, the activity implementation returns the final output container to the MQSeries Workflow program execution server. Any resources held by your program are deallocated. The return value of your program tells the program execution server about the overall outcome of your program.

The output container as well as the return code of your program are passed back to the MQSeries Workflow server which requested the execution of the activity implementation. The return code (_RC) can be used in exit or transition conditions in order to guide MQSeries Workflow navigation. [3]

As a last step, you disconnect from the MQSeries Workflow API so that resources held by the API are deallocated correctly.

Your activity implementation can also behave like a client application and request services from an MQSeries Workflow server, normally the server from where its execution had been triggered. The Passthrough() API call is then used instead of the Logon() API call in order to log on to the server which caused the program execution with the user identification and authority known to the server from the work item start request.

Compiling and linking

C and C++ programs for MQSeries Workflow for OS/390 must be compiled with IBM C/C++ for OS/390 Version 2 Release 4 or later.

All C and C++ programs developed for use with MQSeries Workflow must include header files provided by MQSeries Workflow and link the corresponding library files.

When using the MQ Workflow C++ API, definitions for bool, string, and vector must be provided. MQ Workflow delivers some files to be included: bool.h, which provides for the bool definition and must be included first, fmcjstr.hxx, which provides for the string definition, and vector.h, which provides for the vector definition.

Note that bool.h and vector.h are part of the Standard Template Library delivered with MQ Workflow and copyrighted by the Hewlett-Packard Company. Documentation of this library is provided on the MQ Workflow CD-ROM (non-390 version) in a file named STLDOC.PS. It is installed in the stl subdirectory of the API.

The MQSeries Workflow features you use determine which header files to include and the compilers you use which library files to link with. Depending on the feature used, the following header files must be included:

Feature	C header	C++ header
Runtime client	fmcjcrun.h	fmcjprun.hxx
Runtime activity implementation: - container access only (Container API)	fmcjccon.h	fmcjpcon.hxx

3. For compilers which do not support an exit code of an application, it is possible to set the _RC data member of the output container.

C and C++ interface

Feature	C header	C++ header
- container and server access (Full API)	fmcjcrun.h	fmcjprun.hxx

Table 3. JCLs provided for C/C++ programs

Job	Sample
Native OS/390 C/C++ Full API compile job	FMCHJ1CF
Native OS/390 C/C++ API run job	FMCHJ1CR
CICS C/C++ Full API compile job	FMCHJ2CF
CICS C/C++ Container API compile job	FMCHJ2CC
IMS C/C++ Container API compile job	FMCHJ3CC

For more information about CICS/IMS specifics like stubs or precompiler, refer to the documentation for these components.

The compilers given as prerequisites or newer versions can be used to compile and link your applications accessing the MQSeries Workflow API. Your compile and link options must ensure that the MQSeries Workflow API is called with the calling convention that is defined in the FMC_APIENTRY macro (see file fmcjcglo.h). FMC_APIENTRY has been defined to the standard C calling convention and will be automatically be applied when you use the header files provided by MQSeries Workflow.

Access can be gained to C functions using calls from all languages that support C calls.

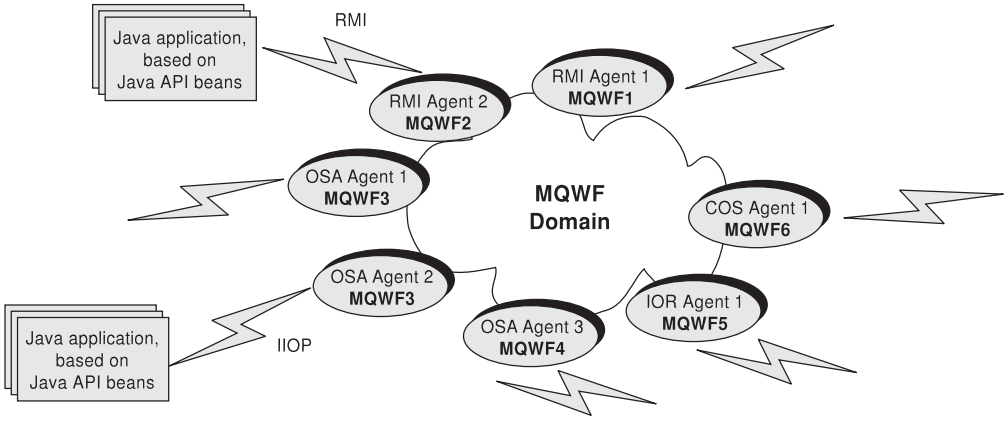
Java interface

Note: The following section describes the general Java environment supported by the LAN version of MQSeries Workflow. Only selected components of this environment, namely the local bindings and the Java agent, are currently implemented in the OS/390 version.

The MQSeries Workflow Java API consists of:

- An agent that connects an MQSeries Workflow domain to the Java world.
- A set of API Beans that provide MQSeries Workflow API functionality to Java based applications.

The Java CORBA Agent



In order to support *thin clients*, a Java agent approach has been chosen. The Java CORBA Agent serves as a proxy for the MQSeries Workflow domain.

The Java CORBA Agent is implemented in Java and wraps the MQSeries Workflow C++ API into a form that is accessible from the Java environment. On the one hand, the Java CORBA Agent thus wraps the native product API and on the other hand it publishes a Java form of the API on the network.

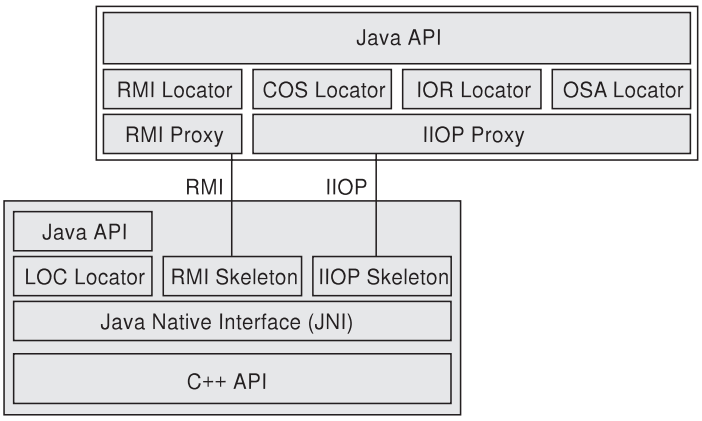
The communication layer

The Java CORBA Agent runs on an MQSeries Workflow machine and Java clients run somewhere on the network. MQSeries Workflow supports CORBA, RMI, and Local environments so that clients can access the agent.

- CORBA is the Object Management Group (OMG) standard for distributed computing. It is very easy to publish existing objects on a network using ORBs. The currently supported ORB is Inprise's VisiBroker Java 3.3.
- Java Remote Method Invocation (RMI) is an approach that is completely Java based and does not require additional software. RMI is included in most Java environments.

  Note: Java RMI agents should only be used for prototyping. They are currently not suited for production purposes.
- Local bindings offer a special mechanism which imbeds the Java CORBA Agent. They bypass the communication layer and use procedure calls. If client applications use local bindings, then they have to consider the trade-off that they become MQSeries clients. It follows that local bindings are best suited for agent side applications, for example, *servlets* and Java-based non-GUI activity implementations.

The locator methods



In theory, there are a number of methods available to clients for finding their agent. These different methods are listed below.

Note: The only method currently supported by OS/390 is LOC naming.

- OSA naming: a VisiBroker specific naming facility (Smart Agent) that is very easy to use. It only requires one OSAgent running on the subnetwork that keeps track of all the objects and their name in the network. As smart agents synchronize their information via UDP, the only thing that has to be known is the name of the object the client program is looking for.
- IOR naming: Via InterOrbReferences a vendor-independent naming service for CORBA applications exists. The identity of a specific object (its IOR) is published in a file on a Web server. This file can be accessed from clients via a published URL to obtain the actual reference of an object.
- COS naming: CORBA Naming Service is the native CORBA directory service. Objects can use COS to publish their identity to the CORBA system.
- RMI registry: The RMI registry comes with every Java development kit. It can be run as a stand-alone program where object implementations register or it can be embedded into the application. Embedding has the big advantage that no separate program is necessary to provide naming functions. To locate objects via the RMI registry, the host which runs the RMI registry has to be known.

  Note: Java RMI agents should only be used for prototyping. They are currently not suited for production purposes.
- LOC naming: This approach can be used to connect the Java API to an MQSeries Workflow C++ API that is located on the same physical machine. This approach can be useful if a client is to be written on a platform that offers the API but does not offer a native client, for example, on AIX. It can also be used to access the MQSeries Workflow API from a Web server through servlet technology without the additional communication overhead, because local bindings use procedure calls.

  Note: This method is the only method currently supported on OS/390.

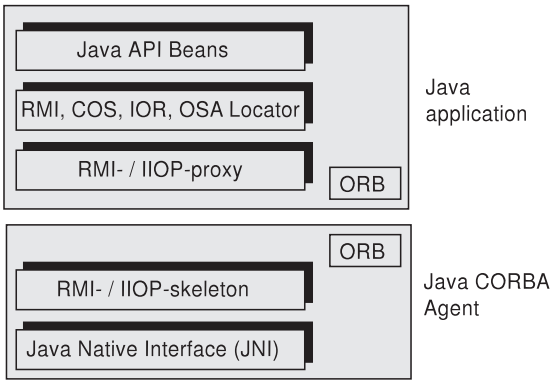
The Java API Beans

Both the client-side communication layer and the API Beans layer are implemented in Java. This makes it possible to run applications developed with the MQSeries Workflow Java API on any machine that provides a Java Virtual Machine (JVM).

The API Beans provide functionality equivalent to the other MQSeries Workflow APIs. Due to the introduction of an agent, its name, context, and locator policy must be specified, however.

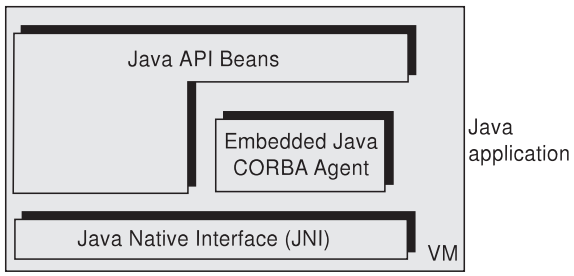
Following are some usage scenarios of the Java API.

Java in the intranet



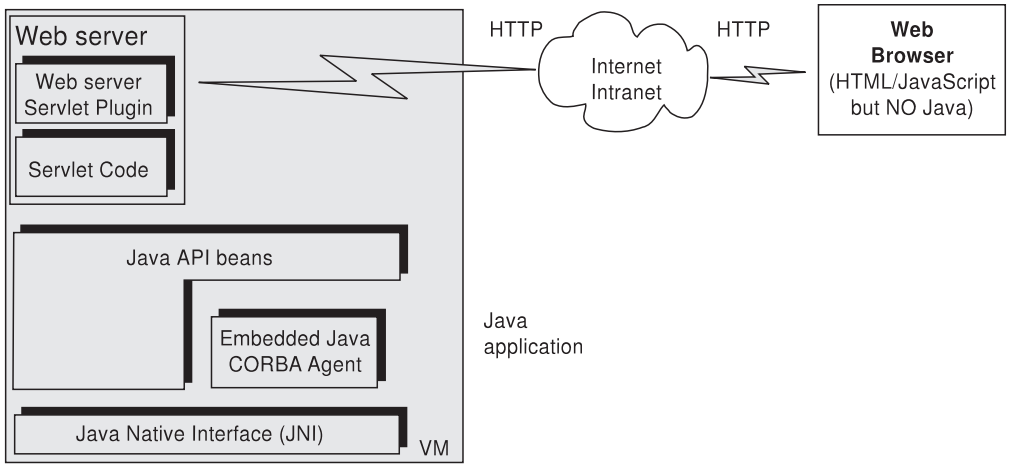
In this case, a non-LOC locator policy must be used and an external agent must be specified. The API Beans and, for a non-RMI protocol, the VisiBroker ORB (COS,IOR,OSA) must have been installed.

Java as a programming language



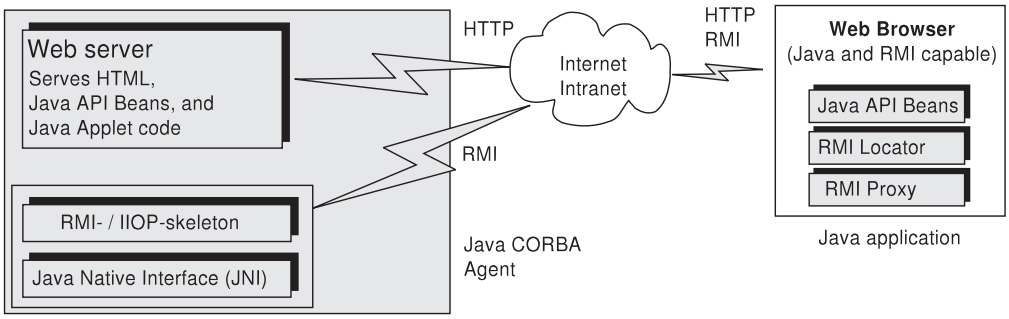
In this case, the LOC_LOCATOR policy of the Java CORBA Agent is used. The Java API Beans must have been installed.

Java in the Internet (servlet)



In this case, a LOC_LOCATOR policy must be used. The API Beans must have been installed.

Java in the Internet (applet/RMI)



In this case, an RMI_LOCATOR policy must be used and an RMI agent must be specified. An RMI Agent and the Java API Beans must have been installed. The applet must be specified in the context of the agent object.

Coding an MQSeries Workflow client application in Java

Coding an MQSeries Workflow Java client application typically contains the following parts (which may not be delimited this clearly, however):

```
                 import java packages
                 void main()
                 {
                   Declare objects
Setup                    :
                   Allocate agent
                   Set Locator or Configuration / set Name
                   Locate service object
                   Logon()

Actions            MQSeries Workflow API calls

Cleanup            Logoff()
                 }
```

To set up your program, you typically declare the program variables or objects you are going to use and you import the MQSeries Workflow Java API packages you need for your actions.

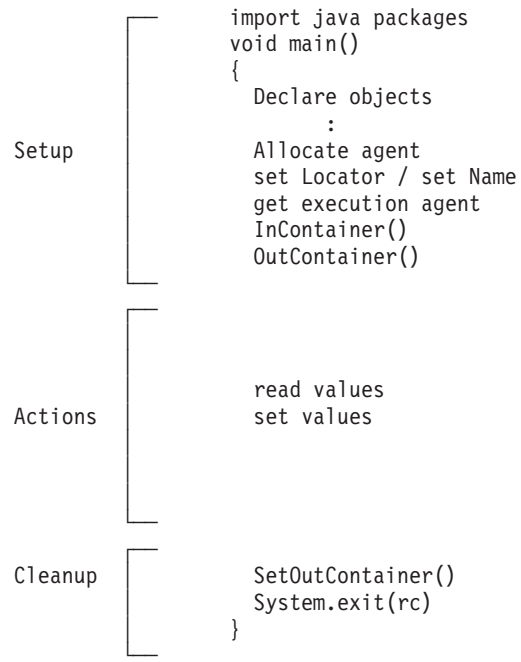
You then need to access a service object which represents the server you are going to ask services from. You do this by locating it via an appropriate agent. Once the service object is allocated, you can log on. Logon establishes a session between the user logging on and the server represented by your service object. All subsequent calls requiring client/server communication run through this session.

After a successful logon, you can issue action or program execution management methods in order to query or manage MQSeries Workflow objects you are authorized for.

At the end of your program, you log off in order to close the session to the server.

Coding an MQSeries Workflow activity implementation in Java

An MQSeries Workflow Java activity implementation typically contains the following parts:



To set up your program, you typically declare the program variables or objects you are going to use and you import the MQSeries Workflow Java API packages you need for your actions.

You then need to locate your execution agent object. You do this by allocating and asking the appropriate agent.

On platforms other than OS/390, an activity implementation can then retrieve the activity's input and output containers from the MQSeries Workflow program execution agent that started this program. On OS/390, the activity implementation in CICS or IMS gets input and output containers when it is started by the PES.

Having access to the containers, you can read and set values according to your programming logic.

At the end of your program, the activity implementation returns the final output container to the MQSeries Workflow program execution server. The return value tells the program execution server about the overall outcome of your program.

The output container is passed back to the MQSeries Workflow server which requested the execution of the activity implementation. The return code (_RC) can be used in exit or transition conditions in order to guide MQSeries Workflow navigation.

Your activity implementation can as well behave like a client application (see "Coding an MQSeries Workflow client application in C or C++" on page 125) and request services from an MQSeries Workflow server, normally the server from where its execution had been triggered. The Passthrough() method is then used

instead of the Logon() method in order to log on to the server which caused the program execution with the user identification and authority known to the server from the work item start request.

Note: An activity implementation currently supports the LOC_LOCATOR policy only.

Compiling

All programs developed for use with the MQSeries Workflow Java API Beans must import the packages provided by MQSeries Workflow. These files have been installed on your system.

JDK 1.1.x (x=6 or higher) can be used to compile and run your applications accessing the MQSeries Workflow Java API. A sample compile statement is:

```
javac -O <java file>.java
```

-O is an optional parameter denoting an optimized build. The CLASSPATH must point to fmcojapi.jar.

See *MQSeries Workflow for OS/390: Customization and Administration* for information on how to set up your system to use Java for OS/390.

Object management

Workflow process models, their instances, and resulting work items are all objects persistently stored in an MQSeries Workflow database. This means that they exist independently from an application program.

When persistent objects are queried by an application program, they are represented by *transient objects* which carry the states of the persistent objects at the time of the query. When multiple queries are issued, there can be multiple transient objects representing the same persistent object, even representing different states of that object.

The lifetime of transient objects is *fully managed* by you, because you know best when those objects are no longer needed, that is, when objects are unreferenced. Transient objects are, however, no longer available when your application program ends.

Some transient objects are *explicitly allocated* by you. These support objects that do not reflect persistent ones. Examples are the Agent or the ExecutionService object, which allows services to be requested from an execution server.

Transient objects, which do reflect persistent objects, are *implicitly allocated* by you when you create or retrieve persistent objects, for example, by querying.

Although the lifetime of transient objects is fully managed by you, their actual internal object structure is encapsulated by the MQSeries Workflow API.

As all resource memory is, in the end, owned by the application process itself, you can access all objects from different threads within that process. MQSeries Workflow does not hinder you from using threads, if they are supported; it is coded reentrantly. On the other hand, MQSeries Workflow does not explicitly support threads. If you want to access the same transient object from within different threads, you must synchronize the access to that object. Objects are **not** thread-safe.

Garbage collection when using Java API Beans

Garbage collection normally runs in the background without intervention by the Java programmer. This is also true in a distributed Java environment when objects communicate via the RMI transmission protocol. However, for other protocols, like CORBA's IIOP, provisions to remove unreferenced objects on the agent side have to be made. When CORBA is used, then the memory management implicitly run by a Java Virtual Machine does not synchronize object removal on a client and the agent. Agent-side counterparts of unreferenced client objects are not automatically marked for removal. The Object Request Broker (ORB) cannot determine if any client is holding or not holding references to objects that it has registered (some ORBs can in fact do that, but they are using proprietary CORBA extensions to achieve this). Agent-side counterparts of client objects registered with an ORB by using a connect method have to be disconnected explicitly. When using MQSeries Workflow Java API Beans, the user is provided with a build-in garbage collection mechanism, the MQSeries Workflow Java API Beans Reaper, which does housekeeping when the transmission of data is done by a CORBA Object Request Broker (ORB). Before starting the MQSeries Workflow Java API Beans Agent a set of parameters controlling the reaper have to be set. These control parameters are:

- The reaper cycle time value, defined in milliseconds, is valid for both the client's reaper and the server's reaper. The default value is 300000 ms (5 minutes).
- The reaper threshold value is set to determine a maximum count for accumulated objects that are no longer referenced. The threshold takes precedence over the cycle time. Default value is 1000.
- The reaper ratio defines the relation between cycle times of both, client side reaper and server side reaper. The ratio is used as a multiplier for the server's reaper cycle, to calculate the cycle time for the client's reaper. The default value is 90, that means in fact 90% of the server's reaper cycle time. This ensures that the client side reaper actions always precede the server's side reaper actions.

The parameters are initially set at configuration time.

COBOL interface

The COBOL API runs as a layer on top of the C API, i.e., the COBOL CALL statements are effectively translated into the C functions with the same name. For this reason, what is said about the C API in this book generally applies to COBOL as well.

There are two ways to use the COBOL API:

1. directly through the Language Environment (LE) ″CALL″ mechanism.
2. by using the FMCPERF copybook and the COBOL ″PERFORM″ mechanism, which in turn uses the ″CALL″ mechanism.

Note: The COBOL calling sequences illustrated in the individual API descriptions are excerpts from FMCPERF.CPY. The paragraph name shown in each case is the name to be used as the PERFORM operand.

Calling the API

The COBOL API uses Language Environment (LE) interlanguage calls (ILCs) to call the C API. Therefore the compiler option PGMNAME(LM) must be used to allow

a) calls to functions with names longer than 30 characters

b) case sensitivity in function names

String handling

Since C strings (char *) are null-terminated, the COBOL programmer must provide null-terminated string parameters. String output parameters must be checked for the first occurrence of X'00' to get the correct value. A function cannot be called with String/PIC X(n) constants but rather must use a pointer referencing such a null-terminated PIC X(n).

Coding an MQSeries Workflow client application in COBOL

An MQSeries Workflow client application typically contains the following parts (which may not be delimited this clearly, however):

```
                IDENTIFICATION DIVISION.
                PROGRAM-ID. "SAMPAPPL".
                   :
                ENVIRONMENT DIVISION.
                   :
                DATA DIVISION.
                WORKING-STORAGE SECTION.

                  copy fmcrcs.
Setup             copy fmcvars.
                  copy fmcconst.

                  Declare objects

                PROCEDURE DIVISION.
                  Connect
                  Allocate service object
                  Logon

Actions           MQSeries Workflow API calls

                  Logoff
                  Deallocate service object
                  Disconnect
Cleanup           GOBACK.

                  copy fmcperf.
                END PROGRAM "SAMPAPPL"
```

To set up your program, you typically declare the program variables or objects you are going to use and copy the MQSeries Workflow API copybooks you need for your actions.

You should then initialize the MQSeries Workflow API via the Connect API call so that resources held by the API are allocated correctly. Connect and Disconnect are to be called at the beginning and end of each thread, respectively.

You then need to allocate a service object which represents the server you are going to ask services from. Once the service object is allocated, you can log on.

Logon establishes a session between the user logging on and the server represented by your service object. All subsequent calls requiring client/server communication run through this session.

After a successful logon, you can issue action or program execution management API calls in order to query or manage MQSeries Workflow objects you are authorized for.

At the end of your program, you log off in order to close the session to the server and you deallocate any resources held by your program, especially the service object.

As a last step, you disconnect from the MQSeries Workflow API so that resources held by the API are deallocated correctly.

Coding an MQSeries Workflow activity implementation in COBOL

An MQSeries Workflow or activity implementation typically contains the following parts:

```
                IDENTIFICATION DIVISION.
                PROGRAM-ID. "SAMPAI".
                   :
                ENVIRONMENT DIVISION.
                   :
                DATA DIVISION.
                WORKING-STORAGE SECTION.

                  copy fmcrcs.
Setup             copy fmcvars.
                  copy fmcconst.

                  Declare objects

                PROCEDURE DIVISION.
                  Connect
                  InContainer
                  OutContainer

Actions           read values
                  set values

                  SetOutContainer
                  Deallocate objects
                  Disconnect
Cleanup           GOBACK.

                  copy fmcperf.
                END PROGRAM "SAMPAI"
```

To set up your program, you typically declare the program variables or objects you are going to use and copy the MQSeries Workflow API copybooks you need for your actions.

You should then initialize the MQSeries Workflow API via the Connect API call so that resources held by the API are allocated correctly. Connect and Disconnect are to be called at the beginning and end of each thread, respectively.

An activity implementation can then retrieve the activity's input and output containers from the MQSeries Workflow program execution server that started this program.

Having access to the containers, you can read and set values according to your programming logic.

At the end of your program, the activity implementation returns the final output container to the MQSeries Workflow program execution server. Any resources held by your program are deallocated. The return value tells the program execution server about the overall outcome of your program.

The output container as well as the return code of your program are passed back to the MQSeries Workflow server which requested the execution of the activity implementation. The return code (_RC) can be used in exit or transition conditions in order to guide MQSeries Workflow navigation.

As a last step, you disconnect from the MQSeries Workflow API so that resources held by the API are deallocated correctly.

Your activity implementation can also act like a client application (see "Coding an MQSeries Workflow client application in C or C++" on page 125) and request services from an MQSeries Workflow server, normally the server from where its execution was triggered. The Passthrough API call is then used instead of Logon in order to log on to the server which initiated program execution, with the user identification and authority known to the server from the work item start request.

Compiling and linking

COBOL programs must be compiled using IBM COBOL for OS/390 and VM, Version 2 Release 4 or higher.

The following copybooks are delivered with MQSeries Workflow for OS/390:

Table 4. Copybooks provided for COBOL programs

Copybook	Contents
FMCCONST	Constants
FMCRCS	Return codes
FMCPERF	Subprograms of full API
FMCPERFL	Subprograms of the Container API
FMCVARS	Variables

If you use the PERFORM mechanism, you must include FMCCONST, FMCRCS, FMCVARS, and either FMCPERF (if your program is using the full API) or FMCPERFL (if your program is an activity implementation using only the Container API).

If you use the CALL mechanism, you need not include any copybooks, but using FMCCONST and FMCRCS will provide you with all the values that MQSeries Workflow defines. FMCVARS can spare you some effort in declaring variables. FMCPERF and FMCPERFL are not useful in this case.

The following JCLs are provided as samples for the development and execution of MQSeries Workflow applications. They are located in the SFMCCNTL library delivered with MQSeries Workflow.

Table 5. JCLs provided for COBOL programs

Job	Sample
Native OS/390 COBOL Full API compile job	FMCHJ1BF
Native OS/390 COBOL API run job	FMCHJ1BR
CICS COBOL Full API compile job	FMCHJ2BF
CICS COBOL Container API Compile Job	FMCHJ2BC
IMS COBOL Container API Compile Job	FMCHJ3BC

For more information about CICS/IMS specifics like stubs or precompiler, refer to the documentation of these components.

The compiler given as a prerequisite or newer versions can be used to compile and link your applications accessing the MQSeries Workflow API.

Mapping C to COBOL data types

Table 6 shows how to map C to COBOL data types:

Table 6. Mapping C to COBOL data types

Type in C	Type in COBOL	BY VALUE / BY REFERENCE
XxxHandle	01 ptr USAGE IS POINTER. (pointing to an object)	BY VALUE
XxxHandle *	01 ptr USAGE IS POINTER. (pointing to a pointer to an object)	BY REFERENCE
char *, char const *	01 ptr USAGE IS POINTER. (pointing to a PIC X(n))	BY VALUE
FmcjCorrelID *	01 ptr USAGE IS POINTER. (pointing to a PIC X(24))	BY VALUE
FmcjBinary *	01 ptr USAGE IS POINTER.	BY VALUE
FmcjCDateTime const *	01 FmcjCDateTime. 05 the-year PIC 9(4) BINARY. 05 the-month PIC 9(4) BINARY. 05 the-day PIC 9(4) BINARY. 05 the-hour PIC 9(4) BINARY. 05 the-minute PIC 9(4) BINARY. 05 the-second PIC 9(4) BINARY.	BY REFERENCE

Table 6. Mapping C to COBOL data types (continued)

Type in C	Type in COBOL	BY VALUE / BY REFERENCE
int, long, signed long, enum	01 int PIC S9(9) BINARY.	BY VALUE
APIRET	01 int PIC S9(9) BINARY.	n/a (not used as parameters)
unsigned long	01 ulong PIC 9(9) BINARY.	BY VALUE
unsigned short	01 ushort PIC 9(4) BINARY.	BY VALUE
double	01 double COMP-2.	BY VALUE
bool (1=true 0=false)	01 bool PIC 9 BINARY.	BY VALUE
long *	01 int PIC S9(9) BINARY.	BY REFERENCE
double *	01 double COMP-2.	BY REFERENCE
unsigned long const *	01 ulong PIC 9(9) BINARY.	BY VALUE[4]

Name changes between COBOL and C

For some of the C functions, synonyms are declared in the form of

```
#define functionA functionB
```

This is to reflect the fact that routines belonging to a superclass are already available to perform the desired function.

In these cases, if you want to call functionA directly via CALL in COBOL, you must use functionB instead. All functions belonging to this category are listed in the table below.

Note: If you use the PERFORM statement with the FMCPERF copybook, you must perform a paragraph whose name is an abbreviated version (see Table 8 on page 146) of the name shown in the left-hand column of the following table. This paragraph then contains a call to the proper COBOL subprogram. For example, to call "FmcjActivityInstanceNotificationSetDescription" via PERFORM, you would code:

```
PERFORM FmcjAINSetDescription
```

which contains

```
CALL FmcjItemSetDescription
```

.

Table 7. Function name mapping

C function	Corresponding COBOL subprogram
FmcjActivityInstanceNotificationCategory	FmcjItemCategory
FmcjActivityInstanceNotificationCategoryIsNull	FmcjItemCategoryIsNull
FmcjActivityInstanceNotificationCreationTime	FmcjItemCreationTime
FmcjActivityInstanceNotificationDelete	FmcjItemDelete
FmcjActivityInstanceNotificationDescription	FmcjItemDescription
FmcjActivityInstanceNotificationDescriptionIsNull	FmcjItemDescriptionIsNull

4. The respective C routine expects the actual value to be passed rather than a pointer thereto. This is apparently the result of internal optimization when the C routine is compiled.

Table 7. Function name mapping (continued)

C function	Corresponding COBOL subprogram
FmcjActivityInstanceNotificationDocumentation	FmcjItemDocumentation
FmcjActivityInstanceNotificationDocumentationIsNull	FmcjItemDocumentationIsNull
FmcjActivityInstanceNotificationEndTime	FmcjItemEndTime
FmcjActivityInstanceNotificationEndTimeIsNull	FmcjItemEndTimeIsNull
FmcjActivityInstanceNotificationEqual	FmcjItemEqual
FmcjActivityInstanceNotificationIcon	FmcjItemIcon
FmcjActivityInstanceNotificationInContainerName	FmcjItemInContainerName
FmcjActivityInstanceNotificationIsComplete	FmcjItemIsComplete
FmcjActivityInstanceNotificationKind	FmcjItemKind
FmcjActivityInstanceNotificationLastModificationTime	FmcjItemLastModificationTime
FmcjActivityInstanceNotificationName	FmcjItemName
FmcjActivityInstanceNotificationObtainProcessInstanceMonitor	FmcjItemObtainProcessInstanceMonitor
FmcjActivityInstanceNotificationOutContainerName	FmcjItemOutContainerName
FmcjActivityInstanceNotificationOwner	FmcjItemOwner
FmcjActivityInstanceNotificationPersistentOid	FmcjItemPersistentOid
FmcjActivityInstanceNotificationProcessAdmin	FmcjItemProcessAdmin
FmcjActivityInstanceNotificationProcessInstance	FmcjItemProcessInstance
FmcjActivityInstanceNotificationProcessInstanceName	FmcjItemProcessInstanceName
FmcjActivityInstanceNotificationProcessInstanceState	FmcjItemProcessInstanceState
FmcjActivityInstanceNotificationProcessInstanceSystemGroupName	FmcjItemProcessInstanceSystemGroupName
FmcjActivityInstanceNotificationProcessInstanceSystemName	FmcjItemProcessInstanceSystemName
FmcjActivityInstanceNotificationReceivedAs	FmcjItemReceivedAs
FmcjActivityInstanceNotificationReceivedTime	FmcjItemReceivedTime
FmcjActivityInstanceNotificationRefresh	FmcjItemRefresh
FmcjActivityInstanceNotificationSetDescription	FmcjItemSetDescription
FmcjActivityInstanceNotificationSetName	FmcjItemSetName
FmcjActivityInstanceNotificationStartTime	FmcjItemStartTime
FmcjActivityInstanceNotificationStartTimeIsNull	FmcjItemStartTimeIsNull
FmcjActivityInstanceNotificationTransfer	FmcjItemTransfer
FmcjActivityInstanceNotificationUpdate	FmcjItemUpdate
FmcjExecutionServiceIsLoggedOn	FmcjServiceIsLoggedOn
FmcjExecutionServiceRefresh	FmcjServiceRefresh
FmcjExecutionServiceSetPassword	FmcjServiceSetPassword
FmcjExecutionServiceSetTimeout	FmcjServiceSetTimeout
FmcjExecutionServiceSystemGroupName	FmcjServiceSystemGroupName
FmcjExecutionServiceSystemName	FmcjServiceSystemName
FmcjExecutionServiceTimeout	FmcjServiceTimeout
FmcjExecutionServiceUserID	FmcjServiceUserID
FmcjExecutionServiceUserSettings	FmcjServiceUserSettings
FmcjProcessInstanceListDelete	FmcjPersistentListDelete

COBOL interface

Table 7. Function name mapping (continued)

C function	Corresponding COBOL subprogram
FmcjProcessInstanceListDescription	FmcjPersistentListDescription
FmcjProcessInstanceListDescriptionIsNull	FmcjPersistentListDescriptionIsNull
FmcjProcessInstanceListFilter	FmcjPersistentListFilter
FmcjProcessInstanceListFilterIsNull	FmcjPersistentListFilterIsNull
FmcjProcessInstanceListName	FmcjPersistentListName
FmcjProcessInstanceListOwnerOfList	FmcjPersistentListOwnerOfList
FmcjProcessInstanceListOwnerOfListIsNull	FmcjPersistentListOwnerOfListIsNull
FmcjProcessInstanceListRefresh	FmcjPersistentListRefresh
FmcjProcessInstanceListSetDescription	FmcjPersistentListSetDescription
FmcjProcessInstanceListSetFilter	FmcjPersistentListSetFilter
FmcjProcessInstanceListSetSortCriteria	FmcjPersistentListSetSortCriteria
FmcjProcessInstanceListSetThreshold	FmcjPersistentListSetThreshold
FmcjProcessInstanceListSortCriteria	FmcjPersistentListSortCriteria
FmcjProcessInstanceListSortCriteriaIsNull	FmcjPersistentListSortCriteriaIsNull
FmcjProcessInstanceListThreshold	FmcjPersistentListThreshold
FmcjProcessInstanceListThresholdIsNull	FmcjPersistentListThresholdIsNull
FmcjProcessInstanceListType	FmcjPersistentListType
FmcjProcessInstanceMonitorActivityInstances	FmcjBlockInstanceMonitorActivityInstances
FmcjProcessInstanceMonitorControlConnectorInstances	FmcjBlockInstanceMonitor ControlConnectorInstances
FmcjProcessInstanceMonitorObtainBlockInstanceMonitor	FmcjBlockInstanceMonitor ObtainBlockInstanceMonitor
FmcjProcessInstanceMonitorObtainProcessInstanceMonitor	FmcjBlockInstanceMonitor ObtainProcessInstanceMonitor
FmcjProcessInstanceMonitorRefresh	FmcjBlockInstanceMonitorRefresh
FmcjProcessInstanceNotificationCategory	FmcjItemCategory
FmcjProcessInstanceNotificationCategoryIsNull	FmcjItemCategoryIsNull
FmcjProcessInstanceNotificationCreationTime	FmcjItemCreationTime
FmcjProcessInstanceNotificationDelete	FmcjItemDelete
FmcjProcessInstanceNotificationDescription	FmcjItemDescription
FmcjProcessInstanceNotificationDescriptionIsNull	FmcjItemDescriptionIsNull
FmcjProcessInstanceNotificationDocumentation	FmcjItemDocumentation
FmcjProcessInstanceNotificationDocumentationIsNull	FmcjItemDocumentationIsNull
FmcjProcessInstanceNotificationEndTime	FmcjItemEndTime
FmcjProcessInstanceNotificationEndTimeIsNull	FmcjItemEndTimeIsNull
FmcjProcessInstanceNotificationEqual	FmcjItemEqual
FmcjProcessInstanceNotificationIcon	FmcjItemIcon
FmcjProcessInstanceNotificationInContainerName	FmcjItemInContainerName
FmcjProcessInstanceNotificationIsComplete	FmcjItemIsComplete
FmcjProcessInstanceNotificationKind	FmcjItemKind
FmcjProcessInstanceNotificationLastModificationTime	FmcjItemLastModificationTime

Table 7. Function name mapping (continued)

C function	Corresponding COBOL subprogram
FmcjProcessInstanceNotificationName	FmcjItemName
FmcjProcessInstanceNotificationObtainProcessInstanceMonitor	FmcjItemObtainProcessInstanceMonitor
FmcjProcessInstanceNotificationOutContainerName	FmcjItemOutContainerName
FmcjProcessInstanceNotificationOwner	FmcjItemOwner
FmcjProcessInstanceNotificationPersistentOid	FmcjItemPersistentOid
FmcjProcessInstanceNotificationProcessAdmin	FmcjItemProcessAdmin
FmcjProcessInstanceNotificationProcessInstance	FmcjItemProcessInstance
FmcjProcessInstanceNotificationProcessInstanceName	FmcjItemProcessInstanceName
FmcjProcessInstanceNotificationProcessInstanceState	FmcjItemProcessInstanceState
FmcjProcessInstanceNotificationProcessInstanceSystemGroupName	FmcjItemProcessInstanceSystemGroupName
FmcjProcessInstanceNotificationProcessInstanceSystemName	FmcjItemProcessInstanceSystemName
FmcjProcessInstanceNotificationReceivedAs	FmcjItemReceivedAs
FmcjProcessInstanceNotificationReceivedTime	FmcjItemReceivedTime
FmcjProcessInstanceNotificationRefresh	FmcjItemRefresh
FmcjProcessInstanceNotificationSetDescription	FmcjItemSetDescription
FmcjProcessInstanceNotificationSetName	FmcjItemSetName
FmcjProcessInstanceNotificationStartTime	FmcjItemStartTime
FmcjProcessInstanceNotificationStartTimeIsNull	FmcjItemStartTimeIsNull
FmcjProcessInstanceNotificationTransfer	FmcjItemTransfer
FmcjProcessInstanceNotificationUpdate	FmcjItemUpdate
FmcjProcessTemplateInContainer	FmcjProcessTemplateInitialInContainer
FmcjProcessTemplateListDelete	FmcjPersistentListDelete
FmcjProcessTemplateListDescription	FmcjPersistentListDescription
FmcjProcessTemplateListDescriptionIsNull	FmcjPersistentListDescriptionIsNull
FmcjProcessTemplateListFilter	FmcjPersistentListFilter
FmcjProcessTemplateListFilterIsNull	FmcjPersistentListFilterIsNull
FmcjProcessTemplateListName	FmcjPersistentListName
FmcjProcessTemplateListOwnerOfList	FmcjPersistentListOwnerOfList
FmcjProcessTemplateListOwnerOfListIsNull	FmcjPersistentListOwnerOfListIsNull
FmcjProcessTemplateListRefresh	FmcjPersistentListRefresh
FmcjProcessTemplateListSetDescription	FmcjPersistentListSetDescription
FmcjProcessTemplateListSetFilter	FmcjPersistentListSetFilter
FmcjProcessTemplateListSetSortCriteria	FmcjPersistentListSetSortCriteria
FmcjProcessTemplateListSetThreshold	FmcjPersistentListSetThreshold
FmcjProcessTemplateListSortCriteria	FmcjPersistentListSortCriteria
FmcjProcessTemplateListSortCriteriaIsNull	FmcjPersistentListSortCriteriaIsNull
FmcjProcessTemplateListThreshold	FmcjPersistentListThreshold
FmcjProcessTemplateListThresholdIsNull	FmcjPersistentListThresholdIsNull
FmcjProcessTemplateListType	FmcjPersistentListType
FmcjProgramDataExecutionMode	FmcjProgramTemplateExecutionMode

COBOL interface

Table 7. Function name mapping (continued)

C function	Corresponding COBOL subprogram
FmcjProgramDataExecutionUser	FmcjProgramTemplateExecutionUser
FmcjProgramDataProgramTrusted	FmcjProgramTemplateProgramTrusted
FmcjReadOnlyContainerAllLeafCount	FmcjContainerAllLeafCount
FmcjReadOnlyContainerAllLeaves	FmcjContainerAllLeaves
FmcjReadOnlyContainerArrayBinaryLength	FmcjContainerArrayBinaryLength
FmcjReadOnlyContainerArrayBinaryValue	FmcjContainerArrayBinaryValue
FmcjReadOnlyContainerArrayFloatValue	FmcjContainerArrayFloatValue
FmcjReadOnlyContainerArrayLongValue	FmcjContainerArrayLongValue
FmcjReadOnlyContainerArrayStringLength	FmcjContainerArrayStringLength
FmcjReadOnlyContainerArrayStringValue	FmcjContainerArrayStringValue
FmcjReadOnlyContainerBinaryLength	FmcjContainerBinaryLength
FmcjReadOnlyContainerBinaryValue	FmcjContainerBinaryValue
FmcjReadOnlyContainerFloatValue	FmcjContainerFloatValue
FmcjReadOnlyContainerGetElement	FmcjContainerGetElement
FmcjReadOnlyContainerLeafCount	FmcjContainerLeafCount
FmcjReadOnlyContainerLeaves	FmcjContainerLeaves
FmcjReadOnlyContainerLongValue	FmcjContainerLongValue
FmcjReadOnlyContainerMemberCount	FmcjContainerMemberCount
FmcjReadOnlyContainerStringLength	FmcjContainerStringLength
FmcjReadOnlyContainerStringValue	FmcjContainerStringValue
FmcjReadOnlyContainerStructMembers	FmcjContainerStructMembers
FmcjReadOnlyContainerType	FmcjContainerType
FmcjReadWriteContainerAllLeafCount	FmcjContainerAllLeafCount
FmcjReadWriteContainerAllLeaves	FmcjContainerAllLeaves
FmcjReadWriteContainerArrayBinaryLength	FmcjContainerArrayBinaryLength
FmcjReadWriteContainerArrayBinaryValue	FmcjContainerArrayBinaryValue
FmcjReadWriteContainerArrayFloatValue	FmcjContainerArrayFloatValue
FmcjReadWriteContainerArrayLongValue	FmcjContainerArrayLongValue
FmcjReadWriteContainerArrayStringLength	FmcjContainerArrayStringLength
FmcjReadWriteContainerArrayStringValue	FmcjContainerArrayStringValue
FmcjReadWriteContainerBinaryLength	FmcjContainerBinaryLength
FmcjReadWriteContainerBinaryValue	FmcjContainerBinaryValue
FmcjReadWriteContainerFloatValue	FmcjContainerFloatValue
FmcjReadWriteContainerGetElement	FmcjContainerGetElement
FmcjReadWriteContainerLeafCount	FmcjContainerLeafCount
FmcjReadWriteContainerLeaves	FmcjContainerLeaves
FmcjReadWriteContainerLongValue	FmcjContainerLongValue
FmcjReadWriteContainerMemberCount	FmcjContainerMemberCount
FmcjReadWriteContainerStringLength	FmcjContainerStringLength
FmcjReadWriteContainerStringValue	FmcjContainerStringValue

Table 7. Function name mapping (continued)

C function	Corresponding COBOL subprogram
FmcjReadWriteContainerStructMembers	FmcjContainerStructMembers
FmcjReadWriteContainerType	FmcjContainerType
FmcjWorkitemCategory	FmcjItemCategory
FmcjWorkitemCategoryIsNull	FmcjItemCategoryIsNull
FmcjWorkitemCreationTime	FmcjItemCreationTime
FmcjWorkitemDelete	FmcjItemDelete
FmcjWorkitemDescription	FmcjItemDescription
FmcjWorkitemDescriptionIsNull	FmcjItemDescriptionIsNull
FmcjWorkitemDocumentation	FmcjItemDocumentation
FmcjWorkitemDocumentationIsNull	FmcjItemDocumentationIsNull
FmcjWorkitemEndTime	FmcjItemEndTime
FmcjWorkitemEndTimeIsNull	FmcjItemEndTimeIsNull
FmcjWorkitemEqual	FmcjItemEqual
FmcjWorkitemIcon	FmcjItemIcon
FmcjWorkitemInContainerName	FmcjItemInContainerName
FmcjWorkitemIsComplete	FmcjItemIsComplete
FmcjWorkitemKind	FmcjItemKind
FmcjWorkitemLastModificationTime	FmcjItemLastModificationTime
FmcjWorkitemName	FmcjItemName
FmcjWorkitemObtainProcessInstanceMonitor	FmcjItemObtainProcessInstanceMonitor
FmcjWorkitemOutContainerName	FmcjItemOutContainerName
FmcjWorkitemOwner	FmcjItemOwner
FmcjWorkitemPersistentOid	FmcjItemPersistentOid
FmcjWorkitemProcessAdmin	FmcjItemProcessAdmin
FmcjWorkitemProcessInstance	FmcjItemProcessInstance
FmcjWorkitemProcessInstanceName	FmcjItemProcessInstanceName
FmcjWorkitemProcessInstanceState	FmcjItemProcessInstanceState
FmcjWorkitemProcessInstanceSystemGroupName	FmcjItemProcessInstanceSystemGroupName
FmcjWorkitemProcessInstanceSystemName	FmcjItemProcessInstanceSystemName
FmcjWorkitemReceivedAs	FmcjItemReceivedAs
FmcjWorkitemReceivedTime	FmcjItemReceivedTime
FmcjWorkitemRefresh	FmcjItemRefresh
FmcjWorkitemSetDescription	FmcjItemSetDescription
FmcjWorkitemSetName	FmcjItemSetName
FmcjWorkitemStartTime	FmcjItemStartTime
FmcjWorkitemStartTimeIsNull	FmcjItemStartTimeIsNull
FmcjWorkitemTransfer	FmcjItemTransfer
FmcjWorkitemUpdate	FmcjItemUpdate
FmcjWorklistDelete	FmcjPersistentListDelete
FmcjWorklistDescription	FmcjPersistentListDescription

Table 7. Function name mapping (continued)

C function	Corresponding COBOL subprogram
FmcjWorklistDescriptionIsNull	FmcjPersistentListDescriptionIsNull
FmcjWorklistFilter	FmcjPersistentListFilter
FmcjWorklistFilterIsNull	FmcjPersistentListFilterIsNull
FmcjWorklistName	FmcjPersistentListName
FmcjWorklistOwnerOfList	FmcjPersistentListOwnerOfList
FmcjWorklistOwnerOfListIsNull	FmcjPersistentListOwnerOfListIsNull
FmcjWorklistRefresh	FmcjPersistentListRefresh
FmcjWorklistSetDescription	FmcjPersistentListSetDescription
FmcjWorklistSetFilter	FmcjPersistentListSetFilter
FmcjWorklistSetSortCriteria	FmcjPersistentListSetSortCriteria
FmcjWorklistSetThreshold	FmcjPersistentListSetThreshold
FmcjWorklistSortCriteria	FmcjPersistentListSortCriteria
FmcjWorklistSortCriteriaIsNull	FmcjPersistentListSortCriteriaIsNull
FmcjWorklistThreshold	FmcjPersistentListThreshold
FmcjWorklistThresholdIsNull	FmcjPersistentListThresholdIsNull
FmcjWorklistType	FmcjPersistentListType

To cope with the COBOL restriction of 30 characters per COBOL word, some class name prefixes and function and constant names have been abbreviated. The abbreviations for the class name prefixes are listed in the table below.

Table 8. Class prefix abbreviations

Class Name	Abbreviation
FmcjActivityInstance	FmcjAI
FmcjActivityInstanceList	FmcjAIL
FmcjActivityInstanceNotification	FmcjAIN
FmcjActivityInstanceNotificationVector	FmcjAINV
FmcjActivityInstanceVector	FmcjAIV
FmcjBlockInstanceMonitor	FmcjBIM
FmcjContainer	FmcjC
FmcjContainerElement	FmcjCE
FmcjContainerElementVector	FmcjCEV
FmcjControlConnectorInstance	FmcjCCI
FmcjControlConnectorInstanceVector	FmcjCCIV
FmcjDllOptions	FmcjDO
FmcjExecutionData	FmcjED
FmcjExecutionService	FmcjES
FmcjExeOptions	FmcjExeO
FmcjExternalOptions	FmcjExtO
FmcjImplementationData	FmcjID
FmcjImplementationDataVector	FmcjIDV

Table 8. Class prefix abbreviations (continued)

Class Name	Abbreviation
FmcjPersistentList	FmcjPL
FmcjPerson	FmcjP
FmcjPoint	FmcjPnt
FmcjPointVector	FmcjPntV
FmcjProcessInstance	FmcjPI
FmcjProcessInstanceList	FmcjPIL
FmcjProcessInstanceListVector	FmcjPILV
FmcjProcessInstanceMonitor	FmcjPIM
FmcjProcessInstanceNotification	FmcjPIN
FmcjProcessInstanceNotificationVector	FmcjPINV
FmcjProcessInstanceVector	FmcjPIV
FmcjProcessTemplate	FmcjPT
FmcjProcessTemplateList	FmcjPTL
FmcjProcessTemplateListVector	FmcjPTLV
FmcjProcessTemplateVector	FmcjPTV
FmcjProgramData	FmcjPD
FmcjProgramTemplate	FmcjPgT
FmcjReadOnlyContainer	FmcjROC
FmcjReadWriteContainer	FmcjRWC
FmcjService	FmcjSrv
FmcjStringVector	FmcjStrV
FmcjSymbolLayout	FmcjSL
FmcjWorkitem	FmcjWI
FmcjWorkitemVector	FmcjWIV
FmcjWorklist	FmcjWL

The abbreviations for function, constant, and error code names are listed in the table below (note that these abbreviations apply after the class name prefix abbreviations). Instead of constructing the names with the help of this table you can also search the FMCPERF copybook for the C function name to get the corresponding COBOL function and variable names.

Table 9. Abbreviations for COBOL naming

Original String	Abbreviation
Activity	Act
ACTIVITY	ACT
Administration	Admin
ADMINSTRATION	ADMIN
Already	Alr
ALREADY	ALR
Authorization	Auth

Table 9. Abbreviations for COBOL naming (continued)

Original String	Abbreviation
AUTHORIZATION	AUTH
Authorized	Auth
AUTHORIZED	AUTH
Backward	Backw
BACKWARD	BACKW
Categories	Categs
CATEGORIES	CATEGS
Category	Categ
CATEGORY	CATEG
CHECKOUT	CHKOUT
Container	Ctnr
CONTAINER	CTNR
ControlConnector	ContrConn
CONTROLCONNECTOR	CONTRCONN
DATA-MEMBER	D-M
Definition	Def
DEFINITION	DEF
Directory	Dir
DIRECTORY	DIR
DOCUMENT	DOC
Executable	Exec
EXECUTABLE	EXEC
EXTERNAL	EXT
ForeGround	ForeGr
FOREGROUND	FOREGR
Forward	Forw
FORWARD	FORW
FOUND-FOR-AUTO-START	FND-FR-AUT-ST
FROM	FRM
IMPLEMENTATION	IMPL
Instance	Inst
INSTANCE	INST
INVALID	INVAL
Invocation	Inv
INVOCATION	INV
Location	Loc
LOCATION	LOC
Mapping	Map
MAPPING	MAP
MESSAGE	MSG

Table 9. Abbreviations for COBOL naming (continued)

Original String	Abbreviation
Monitor	Mon
MONITOR	MON
Notification	Notif
NOTIFICATION	NOTIF
Notified	Notif
NOTIFIED	NOTIF
Object	Obj
OBJECT	OBJ
Organization	Org
ORGANIZATION	ORG
Parameter	Parm
PARAMETER	PARM
PersistentOidOf	PersOidOf
PERSISTENTOIDOF	PERSOIDOF
Persons	Pers
PERSON	PERS
Process	Proc
PROCESS	PROC
Program	Prog
PROGRAM	PROG
Second	Sec
SECOND	SEC
Service	Serv
SERVICE	SERV
Started	Strtd
STARTED	STRTD
STRUCTURE	STR
SUB-PROC	SB-PRC
SUPPORTED	SUPP
Suspension	Susp
SUSPENSION	SUSP
System	Syst
SYSTEM	SYST
Template	Templ
TEMPLATE	TEMPL
Terminated	Term
TERMINATED	TERM
Transition	Trans
TRANSITION	TRANS

COBOL interface

The C API uses some variable names that are reserved words in COBOL. These variable names were changed in the COBOL API by appending ″Value″ to the variable name. All variables belonging to this category are listed below.

```
year      month     day       hour    minute  second   data
file      function  index     input   line    output   owner
password  program   service   time    type    timeout
```

Finally, the variable name ″value″ is used in the C API with different types. In COBOL this variable is renamed according to its type:

intValue, doubleValue, pointerValue

Example of the use of strings

The following code calls a C function with the signature char* cfunc(char* x).

Note: The SETADDR routine sets a pointer variable to the address of a local string. The GETADDR routine copies a string referred to by a pointer variable to a local string.

```
IDENTIFICATION DIVISION.
PROGRAM-ID. "STRTEST".
DATA DIVISION.
  WORKING-STORAGE SECTION.
  01 PTR1 USAGE IS POINTER VALUE NULL.
  01 PTR2 USAGE IS POINTER VALUE NULL.
  01 STRING-STRUCT1.
     05 X PIC X(20).
  01 STRING-STRUCT2.
     05 Y PIC X(20).
  01 STRLEN PIC 99 VALUE 0.
PROCEDURE DIVISION.
    MOVE z"Initial String" TO X.
    CALL "SETADDR" USING STRING-STRUCT1 PTR1.
    CALL "cfunc" USING BY VALUE PTR1
                 RETURNING PTR2.
    CALL "GETADDR" USING STRING-STRUCT2 PTR2.
    INSPECT Y TALLYING STRLEN FOR CHARACTERS
        BEFORE INITIAL X"00".
    DISPLAY "Y is " Y(1:STRLEN).
    STOP RUN.
END PROGRAM "STRTEST".

IDENTIFICATION DIVISION.
PROGRAM-ID. "SETADDR".
DATA DIVISION.
  LINKAGE SECTION.
  01 PTR3 USAGE IS POINTER.
  01 STRING-STRUCT3.
     05 Z PIC X(20).
PROCEDURE DIVISION USING BY REFERENCE STRING-STRUCT3 PTR3.
    SET PTR3 TO ADDRESS OF Z.
    GOBACK.
END PROGRAM "SETADDR".

IDENTIFICATION DIVISION.
PROGRAM-ID. "GETADDR".
DATA DIVISION.
  LINKAGE SECTION.
  01 PTR4 USAGE IS POINTER.
  01 STRING-STRUCT4.
     05 Z PIC X(20).
  01 DUMMY-STRUCT.
     05 W PIC X(20).
PROCEDURE DIVISION USING BY REFERENCE STRING-STRUCT4 PTR4.
```

```
    SET ADDRESS OF DUMMY-STRUCT TO PTR4.
    MOVE W TO Z.
    GOBACK.
END PROGRAM "GETADDR".
```

XML message interface

The following sections provide a description of the MQSeries Workflow XML message-based interface. It explains the format of a message and how XML can be used for:

- Sending requests to MQSeries Workflow

  An action can be started on the execution server by sending a message to the MQSeries Workflow XML input queue.

  This allows any application that supports the MQSeries Workflow XML message format to request an action from MQSeries Workflow.
- Invoking an activity implementation

  An activity implementation is invoked by MQSeries Workflow by sending an appropriate message to a user-defined MQSeries queue.

  This allows you to start any application listening on an MQSeries queue. The queue can be input to any MQSeries application that can handle XML messages. This can be your own application or a commercial program, such as MQSeries Integrator V2.

The MQSeries Workflow message

MQSeries Workflow uses MQSeries to exchange messages. An MQSeries message consists of two parts:

1. The MQSeries message descriptor (MQMD), which contains structured data describing the message
2. The application data, which contains the MQSeries Workflow XML message itself

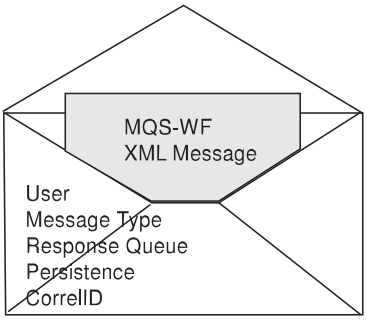


Figure 25. MQSeries Workflow message

Refer to "MQSeries messages" in the *IBM MQSeries Application Programming Guide*.

Relevant MQSeries Message Descriptor (MQMD) fields

The following fields of the MQSeries message descriptor are used by MQSeries Workflow:

- UserIdentifier

  The user who sent the message. For request messages sent to MQSeries Workflow, this information is used as the MQSeries Workflow user on whose behalf the request is performed. Also, authorization checks are performed using

this user ID. For invoke messages sent by MQSeries Workflow, this field contains the user on whose behalf the activity implementation is to be started.

- MsgId

  A fixed string indicating that this message contains an MQSeries Workflow XML message. Its value is "FMCXML".

- ReplyToQ/ReplyToQMgr

  Specifies the queue and queue manager the response should be sent to.

- Persistence

  Specifies whether the message is persistent or transient. For requests sent to MQSeries Workflow, the MQSeries Workflow response has the same persistence as the request. XML requests sent by MQSeries Workflow are persistent and responses sent by invoked activity implementations should also be persistent.

- Expiration

  Can be set to a period of time expressed in tenths of a second for transient messages; should be set to unlimited (MQEI_UNLIMITED) for persistent messages. For requests sent to MQSeries Workflow, the expiration of the MQSeries Workflow response is set to the expiration value in the request minus the time spent on execution. XML requests sent by MQSeries Workflow have an unlimited expiration time.

- CorrelID

  Data that can be used to relate a response message to a request message. For requests sent to MQSeries Workflow, the MQSeries Workflow response contains the same correlation ID as the request. XML requests sent by MQSeries Workflow contain a correlation ID and responses sent by an application should return that correlation ID.

For detailed information, refer to the *MQSeries System Administration*.

The application data

MQSeries Workflow uses the XML 1.0 standard for message description. Refer to

`http://www.w3.org/TR/REC-xml`

for the XML Reference.

In general, an MQSeries Workflow XML message contains the following information:

- An MQSeries Workflow XML message header, that is, information that is common for all messages, for example, the user context
- The request or response, for example, a "ProcessTemplateExecute" request
- The parameters needed to execute the request or to analyze the response, for example, an input container.

When processing an MQSeries Workflow XML message, MQSeries Workflow checks if the message has the correct format.

The XML message header: The MQSeries Workflow XML message header contains the following information:

- If a response should be sent.

  With a message-based interface, both synchronous and asynchronous request/response scenarios can occur. That is why the creation of a response to a

given request is made optional. However, even if responses are generally not desired, an exceptional response to report an error can still be required. Such options are provided to request:

- No ("No")
- Only error ("IfError")
- All ("Yes")

responses which are sent to the response queue specified in the MQMD of the request message.

- The user context

  In this field, you can specify up to 254 bytes of context data that can be used for correlating a request and a response. The user context data specified in a request to MQSeries Workflow is returned in the associated response.

  Therefore, the necessity to keep state information in the component sending the message is avoided. For example, when a message is routed through an intermediary like MQSeries Integrator V2, it can be desirable to route the response back through the intermediary, which then in turn will send the message back to the original requester. The user context data can contain information in order to keep the original requester, or even an entire route, without requiring the intermediary to maintain state information.

Container data: For a general introduction on containers, refer to "Handling containers" on page 30. The following example shows a container with two data structures and one data member that is an array:

```
<!-- Note: The container structure represented here has the following layout:
                 CreditData
                   Customer: CustomerData
                   Amount:   Integer
                   Currency: String
                 End CreditData

                 CustomerData
                   Name:      String
                   Account[2]:Integer
                 End CustomerData
-->
<CreditData>
  <Customer>
    <Name>User1</Name>
    <Account>4711</Account>
    <Account>0007</Account>
  </Customer>
  <Amount>100000</Amount>
  <Currency>CurrencyX</Currency>
</CreditData>
```

The following rules apply to containers in the message-based interface:

- A container is identified by its type, that is, the name of the associated data structure. Container elements are specified by their name; their type is not part of the XML message.
- There are both atomic and complex data structures. Atomic data is mapped to parsed character data (PCDATA) elements, while complex data structures are decomposed into elements according to their structure.
- The structure of XML elements representing a container reflects the associated data structure. Therefore, data member names are not prefixed; there is no need for a dotted name representation.

Note that the context-free nature of XML does not allow for data structures having the same names as data members. Also, two data members with the same name must be of the same type even if they are contained in different data structures. When the MQSeries Workflow Buildtime Verification encounters one of these situations, it issues a warning.

- Atomic elements containing strings and numbers can be coded directly.
- For boolean types, values ″false″ and ″true″ (case insensitive) should be used. Values 0 and 1 are also supported.
- Binary data must be encoded into its printable version (Base 64 encoding). Note that this encoding preserves length information.
- Arrays are represented as a sequence of elements.

The following example shows an XML message that requests the execution of a process instance:

```
<?xml version="1.0" standalone="yes"?>
<WfMessage>
   <WfHeader>
      <ResponseRequired>Yes</ResponseRequired>
      <UserContext>This data is sent back in response</UserContext>
   </WfHeader>
   <ProcessTemplateExecute>
      <ProcTemplName>OnlineCreditRequest</ProcTemplName>
      <ProcInstName>Credit Request #658321</ProcInstName>
      <KeepName>true</KeepName>
      <ProcInstInputData>
          <CreditData>
            <Customer>
              <Name>User1</Name>
              <Account>4711</Account>
              <Account>0007</Account>
            </Customer>
          <Amount>100000</Amount>
          <Currency>CurrencyX</Currency>
          </CreditData>
    </ProcInstInputData>
  </ProcessTemplateExecute>
</WfMessage
```

Code page support

XML allows for the specification of messages in Unicode, as well as in ISO-defined character sets. XML messages sent to MQSeries Workflow are converted from their format as specified in the encoding keyword to the MQSeries Workflow code page as necessary. XML messages sent by MQSeries Workflow (responses and activity implementation invocation requests) are always encoded in Unicode.

Sending requests to MQSeries Workflow

The MQSeries Workflow message-based interface is used to request services from MQSeries Workflow. This is depicted in the following figure:

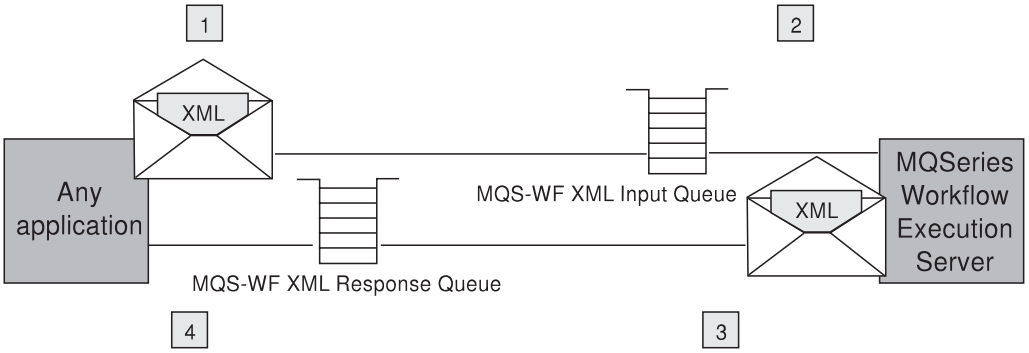


Figure 26. Sending requests to MQSeries Workflow

1. An application creates an MQSeries Workflow XML message and puts it into the MQSeries Workflow XML input queue.
2. The MQSeries Workflow execution server reads the XML message out of the XML input queue and processes the request.
3. The MQSeries Workflow execution server creates an XML message response and puts it into the response queue. The response queue information is part of the MQMD of the incoming XML message.
4. The application reads the incoming message and processes the response.

Supported functions

The following requests are supported by the XML message interface:

- "CreateAndStartInstance()" on page 448.
- "ExecuteProcessInstance()" on page 458.

XML input queue

The XML input queue

```
<prefix>.<SystemGroupName>.<SystemName>.EXE.XML
```

or

```
<prefix>.<SystemGroupName>.EXE.XML
```

is an MQSeries queue to which the MQSeries Workflow execution server is listening.

Only XML messages are accepted as input to this queue. The XML message must conform to the MQSeries Workflow XML message format. If it does not conform, a GeneralError XML message is put into the response queue.

Refer to *MQSeries Installation* for more information about the XML input queue.

Authentication and authorization

For authentication, MQSeries Workflow's message-based interface relies on MQSeries. MQSeries Workflow does not perform any additional authentication. For setting up MQSeries security, refer to ″Protecting MQSeries Objects″ in *MQSeries System Administration*.

The user ID from the MQMD is used as the MQSeries Workflow user on whose behalf the request is to be performed. Authorization checks for that user are performed as usual.

Note: MQSeries user ID constraints differ from the ones defined for the MQSeries Workflow system. Since authorization is checked by MQSeries Workflow, the user ID in the MQMD of an XML message must be a valid MQSeries Workflow user. This has to be ensured by the application programmer and MQSeries Workflow administrator.

Invoking an activity implementation

Activity implementations are usually started by MQSeries Workflow by sending an internal invocation request message to a program execution agent or program execution server. They, in turn, invoke the program that was modeled to implement the activity. Using the message-based interface, it is also possible for MQSeries Workflow to send that invocation request message in XML format to a user-defined MQSeries queue.

From the point of view of MQ Workflow, the MQSeries application listening on that queue has to act like a program execution server. All the necessary information is passed to invoke the activity implementation. The MQSeries application must return with an appropriate response, if requested by MQSeries Workflow.

Therefore, such an application is called a *user-defined program execution server* (UPES). A user-defined program execution server can be any application you write, provided it can deal with the MQSeries Workflow XML message format, or a program such as MQSeries Integrator V2.

MQSeries Workflow can send an invocation request in XML format to a user-defined program execution server if the program activity is modeled to be performed by that UPES. This is done in MQSeries Workflow Buildtime, using the activity property sheet.

Two invocation modes for the activity implementation can also be modeled:

- Synchronous invocation (the standard case), where MQSeries Workflow waits for a completion message containing result data from the UPES before the activity instance is considered to be complete.
- Asynchronous invocation, where no completion message is required and the activity instance is considered to be complete immediately after the invocation message has been sent. No result data can be returned in this case.

The following figure depicts the invocation of an activity implementation:

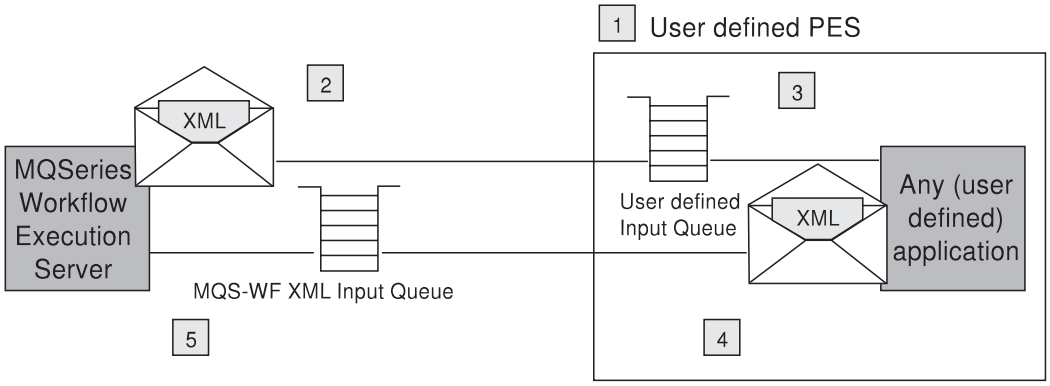


Figure 27. Starting an activity implementation via XML

1. A UPES must have been defined using MQSeries Workflow Buildtime.
2. When an activity implementation is to be started, the MQSeries Workflow execution server sends a program invocation message to the UPES.
3. An application listening to the UPES queue reads the XML message and performs the appropriate action. Possible actions are:
   - Transform the message into another format and route it to another recipient, for example, send an EDI message to another company.
   - Perform a transaction that involves the *get* of the request from the queue, the update of one or more DBMS or other resource managers, and the *put* of the response, in a single unit of work.
   - Invoke the specified activity implementation, for example, call a program on a platform not yet supported by MQSeries Workflow.
4. When the activity implementation has finished, the application creates a response MQSeries Workflow XML message, if required, and puts it into the response queue. Note that the response queue information is part of the MQMD of the incoming XML invocation message.
5. The MQSeries Workflow execution server reads the response message, processes it, and changes the state of the activity accordingly.

User-defined program execution server (UPES)

A UPES is defined and configured for an MQSeries Workflow system by modeling it in MQSeries Workflow Buildtime. Essential attributes are the name and queue it represents. For more information, refer to the online help of MQSeries Workflow Buildtime.

The application that is listening to the UPES queue is not managed by MQSeries Workflow. A system administrator is responsible for administering the application. From an MQSeries Workflow point of view, the invocation of an activity implementation is successful when the invocation message is successfully put into the UPES queue.

Depending on the nature of the activity instance, the activity implementation may only need to be triggered and then runs asynchronously to the MQSeries Workflow process instance, or the process instance navigation has to be synchronized with its completion. In the latter case, a completion message has to be sent to MQSeries Workflow to inform it about the result of execution. In the former case, the activity instance is considered finished as soon as the invocation request is successfully sent. The indication of whether an implementation is to be started synchronously or asynchronously is modeled in Buildtime:

- Synchronous

  The activity implementation is started and the activity instance put into state *Running*. When the activity implementation ends and the MQSeries Workflow execution server receives a completion message, the activity instance is set into the appropriate state, for example, *Finished*.

  Correlation between the request and the response is done by means of the activity implementation correlation ID, which is passed in the invocation request by MQSeries Workflow, and must be passed back in the response

- Asynchronous

  The activity implementation is started and the activity instance is put into the appropriate state, for example, *Finished*. No information on the completion of the activity implementation is expected. If a completion message is received, it is ignored.

Completion message

If the activity implementation is specified to run asynchronously, no completion message is expected. In that case, the successful *put* of the outgoing start activity implementation message is considered to be the complete invocation.

If the activity implementation is specified to run synchronously, a completion message is expected by the MQSeries Workflow execution server. This message can either report the successful execution of the activity implementation, passing the return code and output container, or it can report a failure passing the error and reason code. The error and reason codes must be understood by MQSeries Workflow. See *fmcmretc.h* or *fmcrcs.cpy* for a list of valid codes.

Authorization

For invocation messages sent by MQSeries Workflow, the message header contains the user ID of the user on whose behalf the invocation is to be started. The UPES applications can use this information to implement their own authorization schemes.

Example

```
<ActivityImplInvoke>
    <ActImplCorrelID>FFABCEDF0123456789FF</ActImplCorrelID>
    <Starter>user@systemGroup</Starter>
    <ProgramID>
      <ProcTemplID>84848484FEFEFEFE</ProcTemplID>
      <ProgramName>PerformOrder</ProgramName>
      <ImplementationData>
        <ImplementationPlatform>AIX</ImplementationPlatform>
        <ProgramParameters>/custNo=1234</ProgramParameters>
        <ExeOptions>
          <PathAndFileName>/usr/local/bin/perforder</PathAndFileName>
          <WorkingDirectoryName>/usr/local/data</WorkingDirectoryName>
          <InheritEnvironment>true</InheritEnvironment>
          <StartInForeGround>true</StartInForeGround>
          <AutomaticClose>true</AutomaticClose>
          <WindowStyleVisible>true</Visible>
          <RunInXTerm>true</RunInXTerm>
        </ExeOptions>
      </ImplementationData>
      <ImplementationData>
        <ImplementationPlatform>OS390</ImplementationPlatform>
        <ProgramParameters>/custNo=1234</ProgramParameters>
        <ExternalOptions>
          <ServiceName>CICS42</ServiceName>
          <ServiceType>CICS</ServiceType>
          <InvocationType>EXCI</InvocationType>
          <ExecutableName>ORDR</ExecutableName>
          <ExecutableType>REG1</ExecutableType>
          <IsLocalUser>true</IsLocalUser>
          <IsSecurityRoutineCall>true</IsSecurityRoutineCall>
          <CodePage>850</CodePage>
          <TimeoutPeriod>TimeInterval</TimeoutPeriod>
          <TimeoutInterval>60</TimeoutInterval>
          <IsMappingRoutineCall>false</IsMappingRoutineCall>
        </ExternalOptions>
      </ImplementationData>
      <ProgramInputData>
        <!-- Another container goes here... -->
      </ProgramInputData>
      <ProgramOutputDataDefaults>
        <!-- And yet another container ... -->
      </ProgramOutputDataDefaults>
  </ActivityImplInvoke>

<ActivityImplInvokeResponse>
    <ActImplCorrelID>FFABCEDF0123456789FF</ActImplCorrelID>
    <ProgramRC>0</ProgramRC>
    <ProgramOutputData>
      <!-- Another container comes here... -->
    </ProgramOutputData>
  </ActivityImplInvokeResponse>
```

Figure 28. Sample activity implementation using XML

The MQSeries Workflow XML message format

The following XML syntax is a *document type definition* (DTD) used to describe the format of MQSeries Workflow messages. Note that the following format of a container only contains a suggestion, because the format can vary depending on your setup. Therefore, you cannot use this DTD description to validate your XML message without adding the appropriate specifications for the data structures you use.

You do not have to specify your containers. You are, however, encouraged to do so for future use or to validate them by any other XML application.

```
<!-- FmcXMLIF.dtd == DTD for MQSeries Workflow messages -->
<!-- Message ======================================== -->
<!ELEMENT WfMessage
     ( WfMessageHeader?,
       ( ProcessTemplateCreateAndStartInstance
       | ProcessTemplateCreateAndStartInstanceResponse
       | ProcessTemplateExecute
       | ProcessTemplateExecuteResponse
       | ActivityImplInvoke
       | ActivityImplInvokeResponse
       | GeneralError ) ) >
<!-- ================================================
       Workflow Message Header
     ================================================ -->
<!ELEMENT WfMessageHeader           (ResponseRequired?,UserContext?)>
<!-- Opaque -->
<!ELEMENT UserContext               (#PCDATA) >
<!-- Enumerated type -->
<!ELEMENT ResponseRequired          (#PCDATA)>
                                  <!-- Expected values: {No,IfError,Yes} -->


<!-- ================================================
       Specific Messages
     ================================================ -->
<!-- ProcessTemplateCreateAndStart ================== -->
<!ELEMENT ProcessTemplateCreateAndStartInstance
      ( ProcTemplName,
        ProcInstName,
        KeepName,
        ProcInstInputData ) >
<!ELEMENT ProcessTemplateCreateAndStartInstanceResponse
      ( ProcessInstance
      | Exception ) >


<!-- ProcessTemplateExecute ========================== -->
<!ELEMENT ProcessTemplateExecute
      ( ProcTemplName,
        ProcInstName,
        KeepName,
        ProcInstInputData ) >
<!ELEMENT ProcessTemplateExecuteResponse
      ( ( ProcessInstance,
        ProcInstOutputData )
      | Exception ) >


<!-- ActivityImplInvoke ============================== -->
<!ELEMENT ActivityImplInvoke
      ( ActImplCorrelID,
        Starter,
        ProgramID,
        (ImplementationData)*,
        ProgramInputData,
        ProgramOutputDataDefaults ) >
<!ELEMENT ActivityImplInvokeResponse
      ( ActImplCorrelID,
        ( ProgramRC,
          ProgramOutputData )
```

Figure 29. Document type definition (DTD) for MQSeries Workflow XML messages (Part 1 of 5)

```
      | Exception ) >


<!-- GeneralError ====================================== -->
<!ELEMENT GeneralError  (Exception) >

<!-- ================================================
           Data Structures
     ================================================ -->
<!-- Named Entities ==================================== -->
<!ENTITY  %CONTAINER  "CreditData | InsuranceData | Address | Customer|...">
<!ELEMENT ProcInstInputData          (%CONTAINER;) >
<!ELEMENT ProcInstOutputData         (%CONTAINER;) >
<!ELEMENT ProgramInputData           (%CONTAINER;) >
<!ELEMENT ProgramOutputData          (%CONTAINER;) >
<!ELEMENT ProgramOutputDataDefaults  (%CONTAINER;) >


<!-- Process Instance ================================== -->
<!ELEMENT ProcessInstance
      ( ProcInstID,
        ProcInstName,
        ProcInstParentName?,
        ProcInstTopLevelName,
        ProcInstDescription?,
        ProcInstState,
        LastStateChangeTime,
        LastModificationTime,
        ProcTemplID,
        ProcTemplName,
        Icon,
        Category? ) >


<!-- Program ID ======================================== -->
<!ELEMENT ProgramID
      ( ProcTemplID,
        ProgramName ) >


<!-- Implementation Data =============================== -->
<!ELEMENT ImplementationData
      ( ImplementationPlatform ,
        ProgramParameters,
        ( ExeOptions
        | DllOptions
        | ExternalOptions ) ) >
<!ELEMENT ExeOptions
      ( PathAndFileName,
        WorkingDirectoryName?,
        Environment?,
        InheritEnvironment,
        StartInForeGround,
        AutomaticClose,
        WindowStyle?,
        RunInXTerm ) >


<!ELEMENT DllOptions
      ( PathAndFileName,
```

Figure 29. Document type definition (DTD) for MQSeries Workflow XML messages (Part 2 of 5)

```
        EntryPointName,
        ExecuteFenced,
        KeepLoaded )

<!ELEMENT ExternalOptions
      ( ServiceName,
        ServiceType,
        InvocationType,
        ExecutableName,
        ExecutableType,
        IsLocalUser,

        IsSecurityRoutineCall,
        CodePage,
        TimeoutPeriod,
        TimeoutInterval?,
        IsMappingRoutineCall,
        MappingType?,
        ForwardMappingFormat?,
        ForwardMappingParameters?,
        BackwardMappingFormat?,
        BackwardMappingParameters? ) >


<!-- Exception ======================================== -->
<!ELEMENT Exception
      (Rc, Parameters, MessageText?, Origin) >
<!-- Message text is optional, as it will be ignored
      in messages being sent *to* the Wf server. -->
<!ELEMENT Parameters
      (Parameter*) >


<!-- Data Elements ==================================== -->
<!-- Booleans -->
<!ELEMENT AutomaticClose        (#PCDATA) > <!-- Expected values: {true, false} -->
<!ELEMENT DllV2Compatible       (#PCDATA) > <!-- Expected values: {true, false} -->
<!ELEMENT ExecuteFenced         (#PCDATA) > <!-- Expected values: {true, false} -->
<!ELEMENT InheritEnvironment    (#PCDATA) > <!-- Expected values: {true, false} -->
<!ELEMENT IsLocalUser           (#PCDATA) > <!-- Expected values: {true, false} -->
<!ELEMENT IsMappingRoutineCall  (#PCDATA) > <!-- Expected values: {true, false} -->
<!ELEMENT IsSecurityRoutineCall (#PCDATA) > <!-- Expected values: {true, false} -->
<!ELEMENT KeepLoaded            (#PCDATA) > <!-- Expected values: {true, false} -->
<!ELEMENT KeepName              (#PCDATA) > <!-- Expected values: {true, false} -->
<!ELEMENT RunInXTerm            (#PCDATA) > <!-- Expected values: {true, false} -->
<!ELEMENT StartInForeGround     (#PCDATA) > <!-- Expected values: {true, false} -->


<!-- Strings -->
<!ELEMENT BackwardMappingFormat     (#PCDATA) >
<!ELEMENT BackwardMappingParameters (#PCDATA) >
<!ELEMENT Category                  (#PCDATA) >
<!ELEMENT EntryPointName            (#PCDATA) >
<!ELEMENT Environment               (#PCDATA) >
<!ELEMENT ExecutableName            (#PCDATA) >
<!ELEMENT ExecutableType            (#PCDATA) >
<!ELEMENT ForwardMappingFormat      (#PCDATA) >
<!ELEMENT ForwardMappingParameters  (#PCDATA) >
<!ELEMENT Icon                      (#PCDATA) >
<!ELEMENT InvocationType            (#PCDATA) >
```

Figure 29. Document type definition (DTD) for MQSeries Workflow XML messages (Part 3 of 5)

```
<!ELEMENT MappingType              (#PCDATA) >
<!ELEMENT MessageText              (#PCDATA) >
<!ELEMENT Origin                   (#PCDATA) >
<!ELEMENT Parameter                (#PCDATA) >
<!ELEMENT PathAndFileName          (#PCDATA) >
<!ELEMENT ProcInstDescription      (#PCDATA) >
<!ELEMENT ProcInstName             (#PCDATA) >
<!ELEMENT ProcInstParentName       (#PCDATA) >
<!ELEMENT ProcInstTopLevelName     (#PCDATA) >
<!ELEMENT ProcTemplName            (#PCDATA) >
<!ELEMENT ProgramName              (#PCDATA) >
<!ELEMENT ProgramParameters        (#PCDATA) >
<!ELEMENT ServiceName              (#PCDATA) >
<!ELEMENT ServiceType              (#PCDATA) >
<!ELEMENT Starter                  (#PCDATA) >
<!ELEMENT WorkingDirectoryName     (#PCDATA) >



<!-- Opaque -->
<!ELEMENT ActImplCorrelID          (#PCDATA) >
<!ELEMENT ProcInstID               (#PCDATA) >
<!ELEMENT ProcTemplID              (#PCDATA) >


<!-- Numbers -->
<!ELEMENT CodePage                 (#PCDATA) >
<!ELEMENT ProgramRC                (#PCDATA) >
<!ELEMENT Rc                       (#PCDATA) >
<!ELEMENT TimeoutInterval          (#PCDATA) >


<!-- Timestamps YYYY-MM-DD-hh.mm.ss.000000 (000000 milliseconds) -->
<!ELEMENT LastModificationTime     (#PCDATA) >
<!ELEMENT LastStateChangeTime      (#PCDATA) >


<!-- Enumerated types -->
<!ELEMENT ImplementationPlatform (#PCDATA) > <!--  Expected values:
                                                   { OS2,       AIX,
                                                     HPUX,      Windows95,
                                                     WindowsNT, OS390,
                                                     Solaris } -->

<!ELEMENT ProcInstState          (#PCDATA) > <!--  Expected values:
                                                   { Ready,     Running,
                                                     Finished,  Terminated,
                                                     Suspended, Terminating,
                                                     Suspending,Deleted } -->

<!ELEMENT WindowStyle            (#PCDATA) > <!-- Expected values:
                                                   { Visible,   Invisible,
                                                     Minimized, Maximized } -->

<!ELEMENT TimeoutPeriod          (#PCDATA) > <!-- Expected values:
                                                   { TimeInterval
                                                     Forever    Never } -->


<!-- Container ======================================== -->
```

Figure 29. Document type definition (DTD) for MQSeries Workflow XML messages (Part 4 of 5)

```
<!ELEMENT CreditData     (...) >
<!ELEMENT OrderData      (...) >
<!ELEMENT InsuranceData  (...) >
<!ELEMENT Address        (...) >
<!ELEMENT Customer       (...) >
```

Figure 29. Document type definition (DTD) for MQSeries Workflow XML messages (Part 5 of 5)

XML message interface

Chapter 3. Interfacing with the Program Execution Server

This chapter describes how to write exit routines to interface with the Program Execution Server to map data for legacy applications and to invoke programs.

CICS considerations

In CICS activity implementations, input/output container data is not retrieved from the PEA as in the LAN version but rather sent with the invocation and stored in the COMMAREA. If the user changes the COMMAREA without using the IBM MQSeries Workflow for OS/390 API or once the output container has been set, this data can no longer be retrieved.

For information on how to enable CICS to work with IBM MQSeries Workflow for OS/390, see *IBM MQSeries Workflow: Concepts and Architecture*.

IMS considerations

In IMS activity implementations, input/output container data is not retrieved from the PEA as in the LAN version but rather sent with the invocation and stored in the I/O AREA. If the user changes the I/O AREA without using the IBM MQSeries Workflow for OS/390 API, or once the output container has been set, this data can no longer be retrieved.

IMS programs can use only the Container API, which is a subset of the full MQSeries Workflow API. The Container API is defined in header files *fmcjccon.h* and *fmcjpcon.hxx* and COBOL copybook *fmcperfl.cpy*.

For information on how to enable IMS to work with IBM MQSeries Workflow for OS/390 see *MQSeries Workflow for OS/390: Customization and Administration*.

Notes:

1. An IMS program using the MQSeries Workflow for OS/390 API must issue *at least one* of the following calls:
   - FmcjContainerInContainer
   - FmcjContainerOutContainer
   - FmcjContainerRemoteInContainer
   - FmcjContainerRemoteOutContainer
2. An IMS program using the MQSeries Workflow for OS/390 API must issue *exactly one* of the following calls to return control to the Workflow system:
   - FmcjContainerSetOutContainer
   - FmcjContainerSetRemoteOutContainer

Program mapping via the Program Execution Server

Introduction

Whenever legacy applications are to be invoked by MQSeries Workflow, a mapping of the MQSeries container data into a format acceptable by the legacy application is needed.

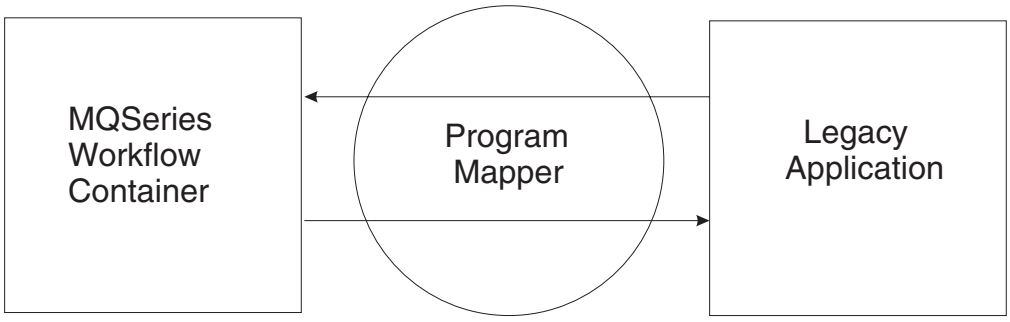


Figure 30. Program mapping illustration.

MQSeries Workflow offers a default program mapper with basic functionality. This section gives a brief overview of the program mapping component of the program execution server (PES). This component does the mapping of MQSeries Workflow containers into a format acceptable by legacy applications. This is a basic mapper so that legacy applications like IMS and CICS are supported. If more complicated mappings are to be done, other mapping tools can be used.

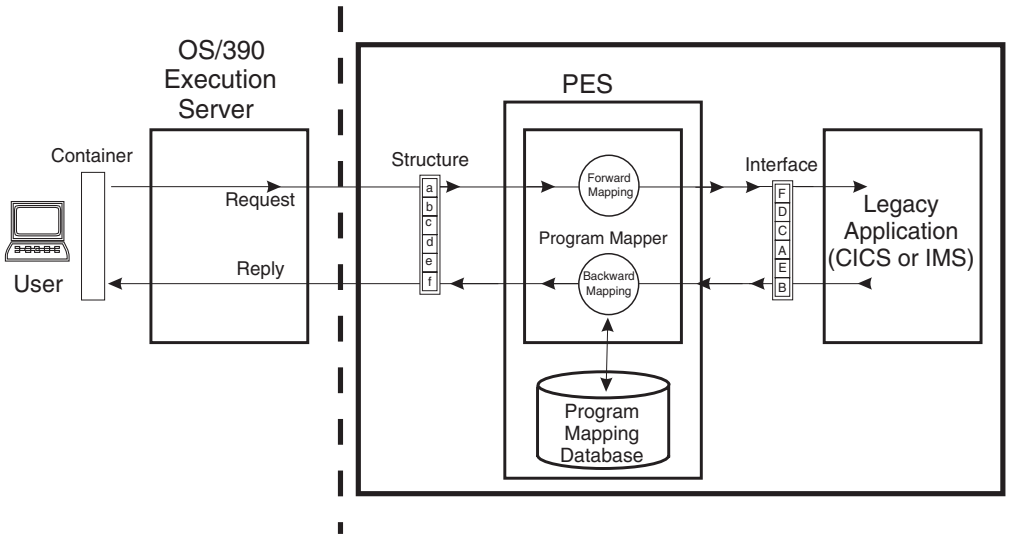


Figure 31. Program mapping control flow

In order to make the format of workflow containers acceptable to legacy applications, the content of the workflow containers is put to an interface called *structure*. The input/output interface for the legacy application is called the *interface*. The task for the program mapper is to convert the data between the structure and interface. Mapping from MQSeries Workflow to the legacy application (a to A, b to B...) is called *forward mapping*, and mapping from legacy applications to MQSeries Workflow (A to a, B to b...) *backward mapping*. If special conversion between structure and interface elements is needed, a usertype exit (which will be explained later) can be used.

Mapping is not necessary if the called application uses Workflow API calls to extract data from the containers.

The way the mapping should be done between structures and interfaces is defined with a **mapping definition language (MDL)**.

To create a mapping, you must first write the definition of the structure and interface elements. You then connect these structures and interfaces with forward/backward mapping definitions, compile the MDL with a parser, and load it into the mapping database. The elements of the mapper are explained in detail in the *MQSeries Workflow for OS/390: Customization and Administration*. The following graphic illustrates the process:

Figure 32. How to create a program mapping.

Program mapping definitions

In this section, the mapping definitions will be explained in more detail. For each definition, a simple example is also given.

Structure definition

A structure defines the MQSeries Workflow container structure that is passed into the program execution server (PES). The structure definition syntax is identical to the structure definition syntax used in the Flowmark definition language (FDL). This allows exporting container definitions from Buildtime into a flat file and copying these structure definitions into the mapping definition language (MDL). A structure mainly consists of a collection of members (structure elements) with a type and cardinality.

Example: This example shows a container in MQSeries Workflow representing an account representative structure. The structure contains the name of the holder of the account (first name and last name defined as a string), the corresponding ZIP (postal) code (defined as long), salary, and tax. The last part of the container is to be filled with the data of customers belonging to the holder of the account. The example for the definition of the CustomerStructure is given later. In order to define the structure you must define each element of the MQSeries Workflow container which is to be passed to the legacy application (the code for a sample legacy application is given in "Additional mapping examples" on page 196).

```
STRUCTURE AccountRepStructure
          LastName:   STRING;
          FirstName:  STRING;
          Zip:        LONG;
          Salary:     FLOAT;
          Tax:        FLOAT;
          Customers:  CustomerStructure(3);
END AccountRepStructure
```

You will find a more detailed example under "Simple data structure with default name mapping" on page 198 and the structure definition grammar under "Structure definition" on page 184.

Interface definition

An interface defines the layout and type of the data accepted by a legacy application. Each interface element has a fixed size and location (offset) and will be filled with converted container elements. There is no way to verify whether the size, location, and type of the elements actually match the size, location, and type expected by the legacy application. This means that the interface definitions must be created carefully. Otherwise, conversion results are unpredictable and runtime mapping errors can occur because of invalid data. Each element of an interface is

mapped to a structure element with the same name. If there is no element with the same name, the interface element is skipped and the container element is unaffected. It is also possible to define a constant for an interface element. See “Constants” on page 175 for more details.

Example: This example shows an interface of a legacy application representing an account representative structure. In this case the name of the holder of the account (first name and last name, defined as a string with a maximum of 50 characters, terminated by hex zero and left-justified with pad character ″ ″), the corresponding ZIP (defined as an unsigned integer with 16 bits), salary, and tax (defined as float with 32 bits). The last part of the container is to be filled with the data of selected customers belonging to the holder of the account. The example for the definition of the CustomerStructure (array for 3 customers using another structure ″CustomerInterfaceForCpp″) is given later. In order to define the interface, you must define each individual element of the container used by the legacy application. The definition of the interface should be as follows:

```
INTERFACE AccountRepInterfaceForCpp
          LastName:   CHAR(50) TERMINATEDBY "<H00>" JUSTIFY LEFT PAD " ";
          FirstName:  CHAR(50) TERMINATEDBY "<H00>" JUSTIFY LEFT PAD " ";
          Zip:        UNSIGNED INTEGER 16;
          Salary:     FLOAT 32;
          Tax:        FLOAT 32;
          Customers:  ARRAY(3) CustomerInterfaceForCpp;
END AccountRepInterfaceForCpp
```

You will find a more detailed example under “Simple data structure with default name mapping” on page 198 and the interface definition grammar under “Interface definition” on page 185. If you have an interface element and no corresponding structure element, no mapping will be done by the default mapper. If it is required to have some constants on the legacy application side, each interface element can optionally have a *constant* statement that defines the constant to create for the legacy application. The constant is converted in forward mapping, whether there is a matching structure element or not. If backward mapping occurs, a structure element is set to this constant only if there is an element with the same name or a mapping rule between the structure and the interface with a constant. See “Constants” on page 175 for more information.

Forward/backward mapping definition

The connection between a structure and an interface is done via a forward and backward mapping definitions. Forward mapping is used to map a structure into a format accepted by a legacy application, and backward mapping is used to map legacy application data into a structure. Mapping done for structure and interface elements with identical names is called *default mapping*. In addition, it is possible, by using rules, to do *explicit mapping* of elements which have different names. Structures are mapped as a whole into interfaces, and arrays are mapped as a whole if both the structure and interface array have the same size. It is not possible to map array elements individually. If more powerful mappings are required, use container mapping (see *IBM MQSeries Workflow: Getting Started with Buildtime*).

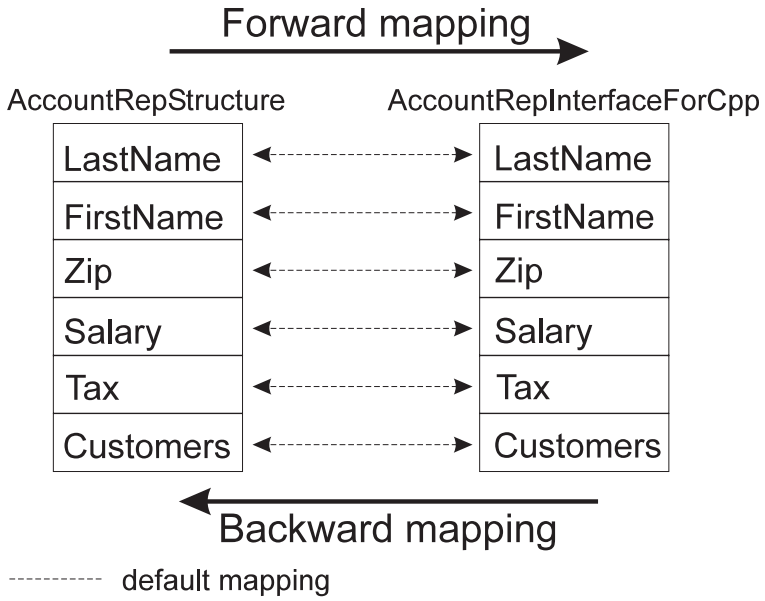


Figure 33. Default forward/backward mapping

To create a forward mapping, you must define which structure is to be mapped to which interface. To create a backward mapping, you must define which interface is to be mapped to which structure. Optionally, you can use rules to map elements with different names. See "Mapping algorithm" on page 172 for more detailed information about default and explicit mapping.

The coding for the mapping according to the diagram would therefore be:

```
/* Mapping from MQSeries Workflow (structure) to legacy appl.(interface) */
FORWARDMAPPING Forward
        FROM AccountRepStructure TO AccountRepInterfaceForCpp
END
/* Mapping from legacy appl. (interface) to MQSeries Workflow (structure) */
BACKWARDMAPPING Backward
        FROM AccountRepInterfaceForCpp TO AccountRepStructure
END
```

Note: All structure and interface elements are mapped because they have identical names (default mapping).

You will find a complete mapping in "Example" on page 176.

Usertype definition

A usertype can be used by the program mapper whenever the interface types provided by a default mapper do not offer the required conversion. In this case the actual data conversion must be done by a usertype exit, which must reside in a DLL. See "Usertype" on page 192.

Example: In order to assign a number to a currency with the corresponding symbol, you need to define a usertype (any mapping type would map the number to the exact number in a different format but not assign it to a special currency). It is also possible to define a usertype that calculates a value of currency A used in the structure to a currency B used in the interface (for example U.S. dollars to British pounds or the new European currency, the euro).

```
USERTYPE SampleUsertype LENGTH(4)
         DLL "SAMPUTY","SampleUsertypeExit"
END
```

Program mapping

```
INTERFACE SampleUsertypeInterface
          DESCRIPTION "Sample Usertype Interface"
          SampleElement: USERTYPE SampleUsertype PARMS "$";
END
```

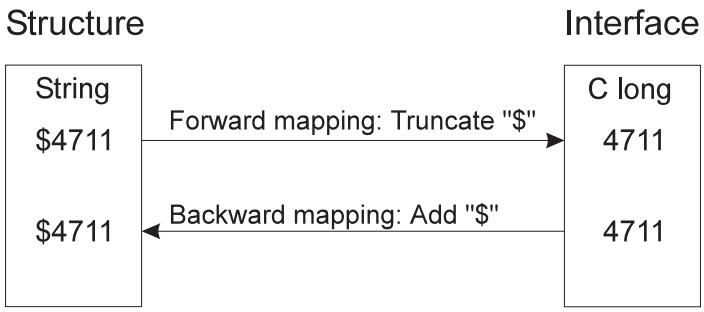


Figure 34. Usertype example

This example shows the functionality of a usertype. An interface element (defined as C long) is mapped to a structure element (defined as a string). In backward mapping, the C long ″4711″ is converted to a string and prefixed with ″$″. In forward mapping the string ″$4711″ is truncated to ″4711″ and then converted to a C long.

Mapping algorithm

All elements in an MQSeries Workflow container have names. The interface elements must also have names. Mapping is done per default on a name-by-name basis if elements have the same name. If element names are different, mapping rules can be used to do explicit mapping.

Structures are mapped as a unit to interfaces if their names are identical. Arrays are also mapped as a unit. It is also possible to define constants that are inserted on the legacy application or container side.

If structure or interface elements are not mapped, the data in the structure element or interface element is not modified.

Note: Each structure element can only be mapped to one interface element and vice versa.

In this example, there are 4 structure and interface elements which are to be mapped by the default mapper.

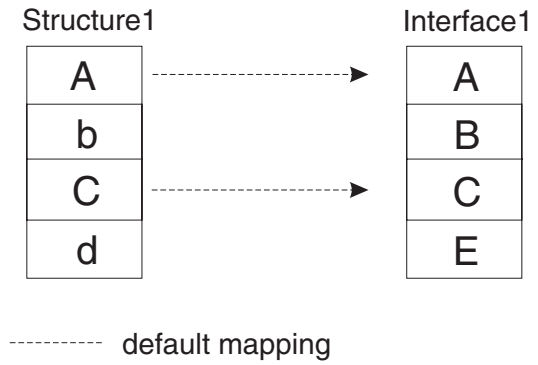


Figure 35. Default forward mapping illustration.

```
FORWARDMAPPING Forward
     FROM Structure1 TO Interface1
END
```

The default mapper maps structure element A to interface element A and structure element C to interface element C. It does *not* map structure element b to interface element B or structure element d to interface element E, because of the different names. See also "Simple data structure with default name mapping" on page 198 for a more detailed example.

If the corresponding structure and interface elements do not have identical names, the mapping must be defined explicitly. In this case you must define an additional mapping rule for the mapping. The mapping definition language (MDL) and the corresponding grammar are explained in "Grammar" on page 181. The following graphic displays a simple forward mapping with some non-identical names of the structure and interface elements.

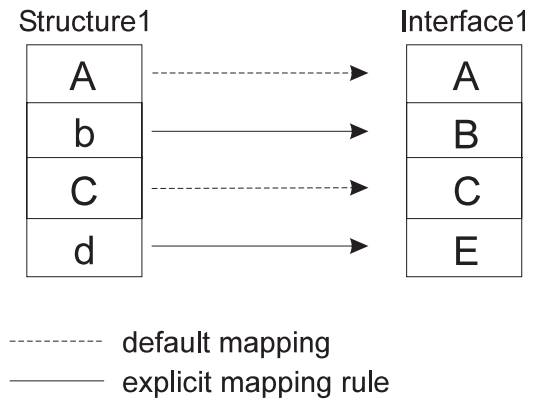


Figure 36. Forward2: Non-default forward mapping illustration.

The mapping rules would follow as:

```
FORWARDMAPPING Forward2 FROM Structure1 TO Interface1
        MAP b TO B;
        MAP d TO E;
END
```

Structure elements A and C do not have to be mapped to interface elements A and C explicitly; this will be done be the default mapper automatically. Refer to "Complex data structure with non-default name mapping" on page 199 for a more detailed example.

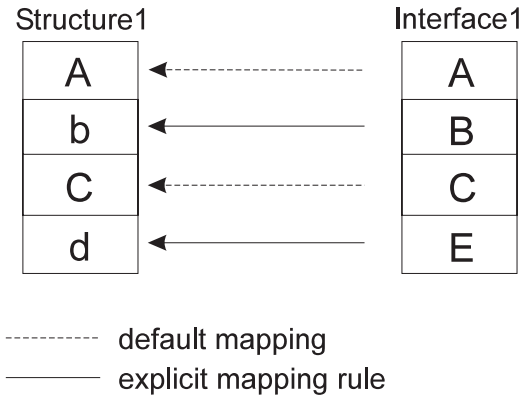


Figure 37. Non-default backward mapping Backward1 illustration.

If you would like a backward mapping according to the above diagram the mapping rules would be:

```
BACKWARDMAPPING Backward1 FROM Interface1 TO Structure1
        MAP B TO b;
        MAP E TO d;
END
```

How you map elements to each other only depends on the definition as long as you do not violate any conversion rules (see "Valid conversions between MQSeries Workflow container program mapping element types and program mapping interface types" on page 178). For example. it is not permissible to map an integer to a binary.

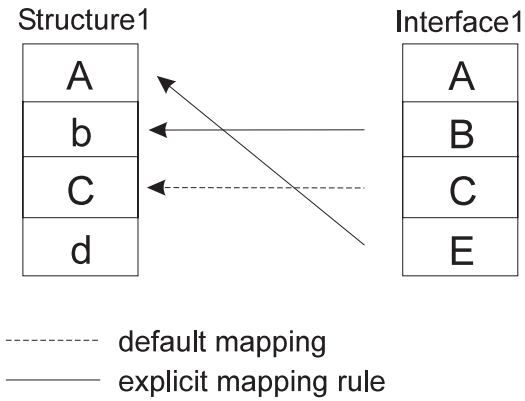


Figure 38. Backward2: Explicit mapping illustration.

In this case the interface element A will not be mapped to structure element A because there is a rule from interface element E to structure element A. Interface element B is mapped because of the explicit rule. Interface element C is mapped to structure element C because they have the same name (default mapping) and

because no explicit mapping for interface element C is defined. Interface element E will be mapped to structure element A because of a mapping rule for interface element E.

```
BACKWARDMAPPING Backward2 FROM Interface1 TO Structure1
        MAP B TO b;
        MAP E TO A;
END
```

Table 10. Rule mapping with no constant definition

	BACKWARDMAPPING	FORWARDMAPPING
There is a definition rule for forward/backward mapping	Map interface element to structure element	Map structure element to interface element
There is *no* definition rule for forward/ backward mapping	Interface element not mapped to structure element	Interface element undefined

Notes:

1. If the mapping rules use invalid or nonexistent interface element names, these rules are ignored during actual mapping. Make sure you use the right names in forward mapping and backward mapping. By contrast, structure element names used in definition rules must exist. Otherwise, runtime errors will occur.
2. Do not map structure elements to interface elements which are used in other arrays. The structure element will contain the interface elements with the largest dimension.

Constants

If it is required to have constants on the legacy application or structure side, each *interface* element can optionally have a constant statement that defines the constant to create for the legacy application or structure element. The constant is converted in forward mapping whether there is a matching structure element or not. If a backward mapping occurs, the structure element is set to this constant only if there is an element with the same name or a rule is defined for this structure element.

Table 11. Mapping with constant definition

	Backward mapping	Forward mapping
There is a definition rule for forward/ backward mapping	Structure element set to constant	Interface element set to constant
There is *no* definition rule for forward/ backward mapping	Structure element **not** set to constant	Interface element set to constant

Example for non-default forward mapping with constant definitions:

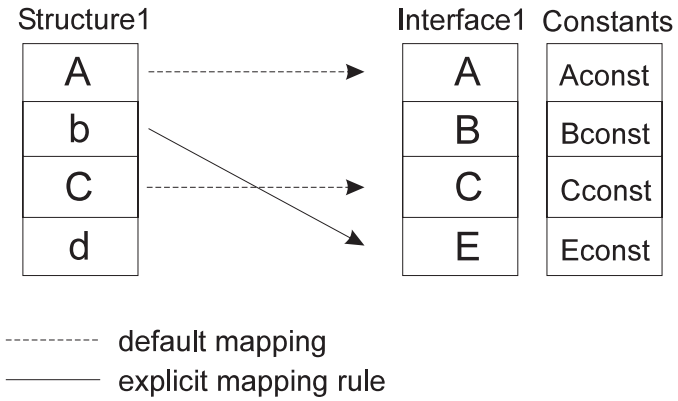


Figure 39. Forward mapping with constants.

Because structure elements A, C and b are mapped to interface elements A, C and E (which all have a constant definition), the interface elements A, C and E are set to Aconst, Cconst and Econst, respectively. The interface element B is set to Bconst because no structure element was mapped to B. So all interface elements are set to their corresponding constant values. In forward mapping, all interface elements with a constant definition are set to their constant whether there is a mapping to this element or not. Only if the interface element has *no* constant definition can a mapping change the value. Refer to "Simple data structure with all interface types with CONSTANTS and usertypes" on page 201 for a more complex example.

Example for default backward mapping with constant definitions:

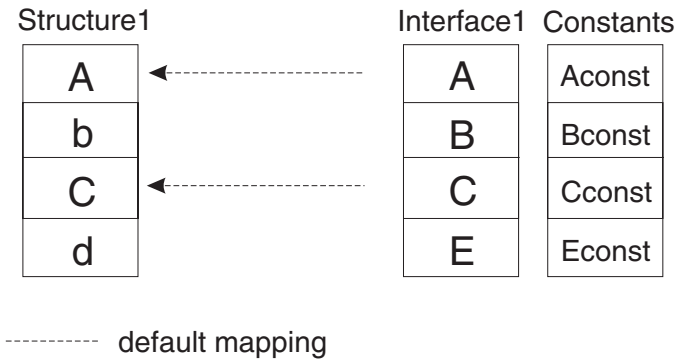


Figure 40. Backward mapping with constants.

Because interface elements B and E are not mapped to structure elements b and d, b and d are *not* set to the constant values of Bconst and Econst. Because interface element A is mapped to structure element A and interface element A has a constant Aconst, the structure element A is set to Aconst (same as structure element C is set to Cconst). Assuming there would be no constant definition for C on the legacy application side, interface element C would have been mapped to structure element C as usual.

Example

In this example, the structure elements and interface elements do not have the same names. Therefore they must be mapped explicitly in the forward/backward mapping definition. If they were not mapped explicitly, no mapping would be done at all, because all structure and interface elements have different names.

```
STRUCTURE AccountRepStructure
          LastName:   STRING;
          FirstName:  STRING;
          Zip:        LONG;
          Salary:     FLOAT;
          Tax:        FLOAT;
          Customers:  CustomerStructure(3);
END AccountRepStructure
INTERFACE AccountRepInterfaceForCpp
          L: CHAR(50) TERMINATEDBY "<H00>" JUSTIFY LEFT PAD " ";
          F: CHAR(50) TERMINATEDBY "<H00>" JUSTIFY LEFT PAD " ";
          Z: UNSIGNED INTEGER 16;
          S: FLOAT 32;
          T: FLOAT 32;
          C: ARRAY(3) CustomerInterfaceForCpp;
END AccountRepInterfaceForCpp
/* Mapping from MQSeries Workflow (structure) to legacy application (interface) */
FORWARDMAPPING Forward FROM AccountRepStructure TO AccountRepInterfaceForCpp
         MAP LastName TO L;
         MAP FirstName TO F;
         MAP Zip TO Z;
         MAP Salary TO S;
         MAP Tax TO T;
         MAP Customers TO C;
END
/* Mapping from legacy appl. (interface) to MQSeries Workflow (structure) */
BACKWARDMAPPING Backward FROM AccountRepInterfaceForCpp TO AccountRepStructure
         MAP L TO LastName;
         MAP F TO FirstName;
         MAP Z TO Zip;
         MAP S TO Salary;
         MAP T To Tax;
         MAP C TO Customers;
END
```

Supported program mapping definition element types

Program mapping structure definition element types

All MQSeries Workflow element types are supported:

- LONG
- FLOAT
- STRING
- BINARY

Program mapping interface definition element types

Characters: Characters have a size in bytes, an optional termination character (hex 0), and justification and padding.

Integer numbers: Integers are either signed or unsigned and have a size in bits. Supported sizes are 16 and 32 bits.

Float numbers: Floats have a size in bits. Supported sizes are 32 and 64 bits.

Packed numbers: Packed numbers have a size, are either signed, with a character for plus and a character for minus, or unsigned with an unsigned character, and have a scale.

Zoned numbers: Zoned numbers have a size, are either signed, with a character for plus and a character for minus, or unsigned with an unsigned character, and have a scale.

Interface: Interfaces have only a name and define another interface used as an interface element. In this way, it is possible to structure the interface in the same way structures can be defined to contain other structures.

Usertypes: Whenever the previous interface types do not match the required types, it is possible to define a usertype. For details see "Grammar" on page 181. Usertypes have a name and an optional parameter string, which can be used to pass additional information to the usertype exit. In order to use a usertype, it must be defined and a usertype DLL with a usertype exit must be provided. (See "Usertype" on page 192 for more details):

Valid conversions between MQSeries Workflow container program mapping element types and program mapping interface types: The following table lists all possible combinations of structure elements and interface elements. If they are arrays, they must have the same size. There is one exception: a character of size 1 can be mapped to an MQSeries Workflow LONG. If an invalid combination is used, a runtime error will be generated (see *MQSeries Workflow for OS/390: Messages and Codes* for detailed information).

Table 12. Mapping combinations

Workflow Type Interface Type	**String**	**Binary**	**Long**	**Float**
CHAR	*	*	*	
INTEGER	*		*	
FLOAT				*
PACKED	*		*	*
ZONED	*		*	*
USERTYPE	*1	*1	*1	*1
Note: [1]Only available if this type of combination is supported by the *usertype* exit				

Table 13. C/C++ data type mappings (legacy application (C/C++) to FDL types (structure))

C/C++ type	Interface	Structure	Comment
char	CHAR(1) JUSTIFY LEFT PAD " "	STRING	No imbedded x'00'
char [5]	CHAR(5) JUSTIFY LEFT PAD " " or CHAR(5) TERMINATEDBY "<h00>" JUSTIFY LEFT PAD " "	STRING	No imbedded x'00'
char	CHAR(1) JUSTIFY LEFT PAD " "	BINARY	
char [5]	CHAR(5) JUSTIFY LEFT PAD " " or CHAR(5) TERMINATEDBY "<h00>" JUSTIFY LEFT PAD "<h00>"	BINARY	
char	CHAR(1) JUSTIFY LEFT PAD "<h00>"	LONG	
short	SIGNED INTEGER 16	LONG, STRING	
unsigned short	UNSIGNED INTEGER 16	LONG, STRING	
int	SIGNED INTEGER 32	LONG, STRING	
unsigned int	UNSIGNED INTEGER 32	LONG, STRING	
long	SIGNED INTEGER 32	LONG, STRING	
unsigned long	UNSIGNED INTEGER 32	LONG, STRING	
float	FLOAT 32	FLOAT	
double	FLOAT 64	FLOAT	

Table 14. COBOL data type mappings (legacy application (COBOL) to FDL types (structure))

COBOL	Interface	Structure	Comment
PIC X(n)	CHAR(n) JUSTIFY LEFT PAD " "	STRING	No imbedded x'00'
PIC X(n)	CHAR(n) JUSTIFY LEFT PAD "<h00>"	BINARY	
PIC X(1)	CHAR(1) JUSTIFY LEFT PAD "<h00>"	LONG	
PIC S999 PACKED-DECIMAL or COMP-3	PACKED(3) SIGNED MINUS "<h0d>" PLUS "<h0c>" SCALE 0	LONG, STRING, FLOAT	
PIC S999PP PACKED-DECIMAL or COMP-3	PACKED(3) SIGNED MINUS "<h0d>" PLUS "<h0c>" SCALE 2	LONG, STRING, FLOAT	
PIC S99V9 PACKED-DECIMAL or COMP-3	PACKED(3) SIGNED MINUS "<h0d>" PLUS "<h0c>" SCALE -1	LONG, STRING, FLOAT	
PIC S9999 BINARY or COMP-4	SIGNED INTEGER 16	LONG, STRING, FLOAT	Up to 4 digits[1]
PIC S9(6) BINARY or COMP-4	SIGNED INTEGER 32	LONG, STRING, FLOAT	Between 5 and 9 digits[1]
COMP-1	FLOAT 32	FLOAT	
COMP-2	FLOAT 64	FLOAT	
PIC S9(n)V9(m) DISPLAY	ZONED(n+m) SIGNED LAST MINUS "-" PLUS "+" SCALE -m	LONG, STRING, FLOAT	
PIC S9(n)V9(m) DISPLAY SIGN LEADING	ZONED(n+m) SIGNED FIRST MINUS "-" PLUS "+" SCALE -m	LONG, STRING, FLOAT	
PIC S9(n)V9(m) DISPLAY SIGN TRAILING SEPARATE	ZONED(n+m) SIGNED LAST MINUS "-" PLUS "+" SEPARATE SCALE -m	LONG, STRING, FLOAT	
PIC 9(n)V9(m) DISPLAY	ZONED(n) UNSIGNED SCALE -m	LONG, STRING, FLOAT	
Note: [1] 8-byte BINARY with 10-18 digits is not supported.			

Grammar

This section describes the program mapper grammar. Base elements of the grammar are tokens, keywords in uppercase, constants and comments. By combining the base elements, you can define mapping elements: forward/backward mapping (FM/BM) and structure/interface definitions (IF, ST). The forward/backward mapping consists of rules (RL) which combine the structure and interface elements (IFE, STE). The following graphic is intended to illustrate the relationship between all these elements.

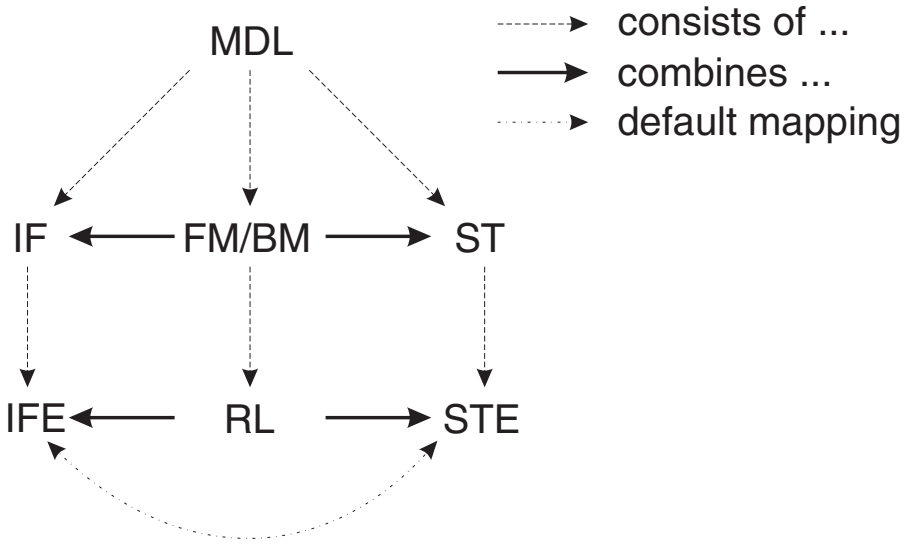


Figure 41. Relationship between mapping elements.

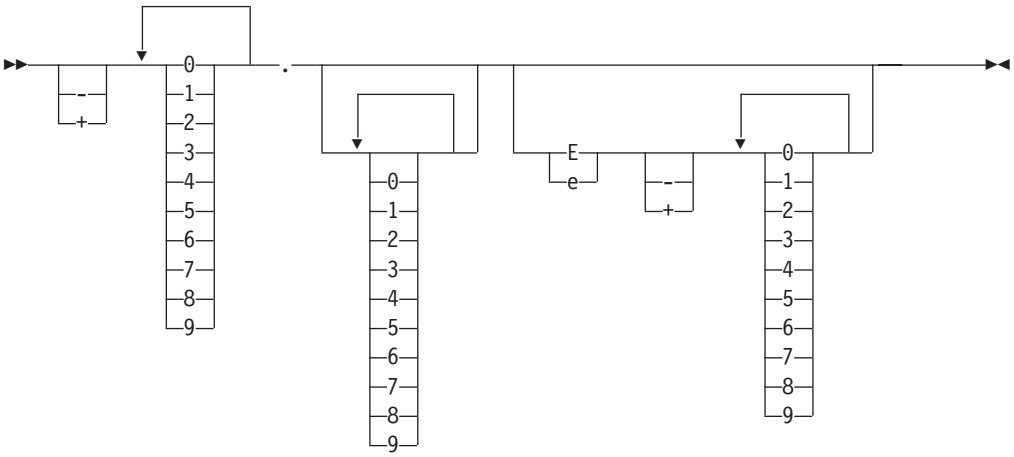
Grammar elements

Comments: Comments should be used to document the mapping definition. There are two types of comments: C style, for example /* 'comment' */ and C++ style, for example // 'comment' at the end of a line.

Comments starting with '/*' and ending with '*/' can be located anywhere between syntax tokens. Comments starting with // can be at the end of any line. Nesting of '/* ... */' is not allowed.

Tokens: Tokens are the base element of the grammar, and each token is therefore explained in detail. For each token, at least a syntax diagram and an example is given.

FLOAT_TOKEN:

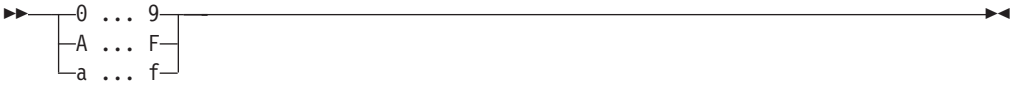


Example: -7.42E-4, which equals -0.000742.

Note: In order to keep the diagrams simple, the possibility of choosing a single number from 0 to 9 will be displayed with

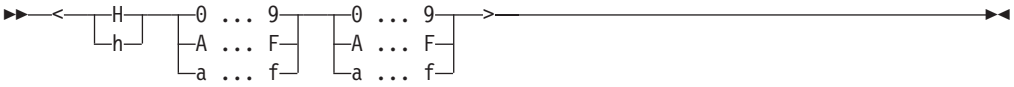
from now on.

Hex_digit:



Examples: 3, F.

Hex_token:



Example: <H4F>

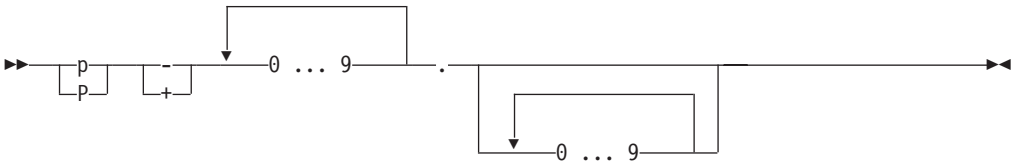
IDENTIFIER:

Examples: a_b4_h4, _Z97_bfsd

INT_TOKEN:

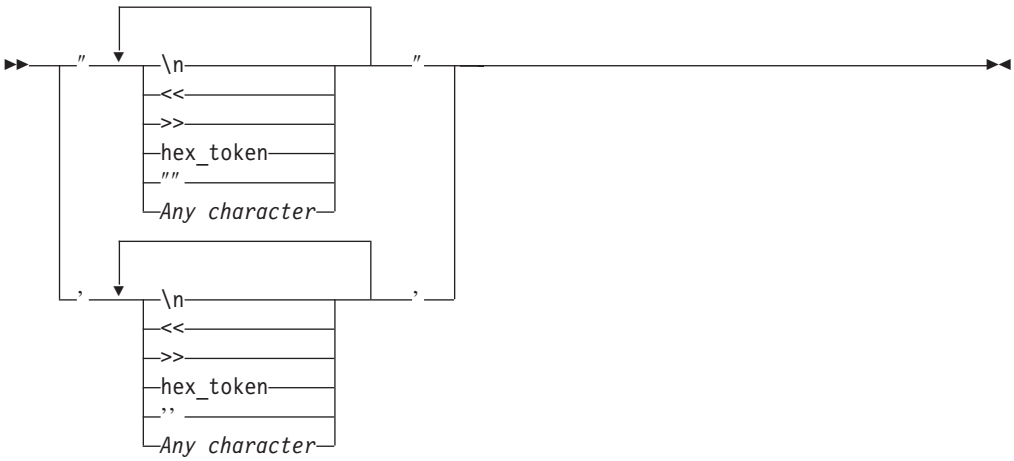
Examples: -89432, 412

PACKED_TOKEN:



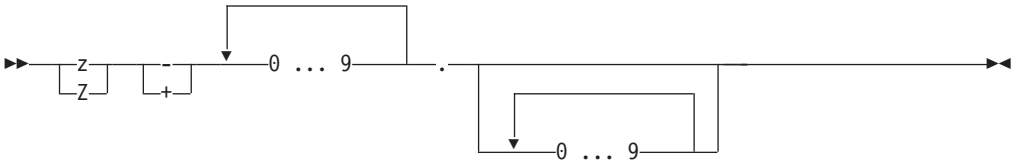
Examples: p+212.2 equals 212.2, p-142.8 equals -142.8

STRING_TOKEN:



Example: "AlbertEinstein", "xyz'a", 'xyz"a', 'other_example<h15><h12>'

ZONED_TOKEN:



Example: z+412.8

Program mapping

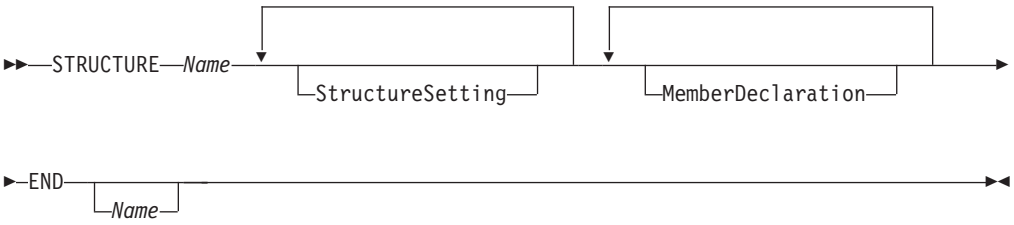
Keywords: Listed below are all available keywords. Do not name variables with these reserved keywords, because this would cause problems when mapping (for example, do not name a structure element 'STRUCTURE').

```
ARRAY           BACKWARDMAPPING BINARY          CHAR
CONSTANT        DESCRIPTION     DLL             DOCUMENTATION
END             FIRST           FLOAT           FORWARDMAPPING
FROM            IGNORE          INTEGER         INTERFACE
JUSTIFY         LAST            LEFT            LENGTH
LONG            MAP             MAPPING         MINUS
PACKED          PAD             PARMS           PLUS
RIGHT           SCALE           SEPARATE        SIGNED
STRING          STRUCTURE       TERMINATEDBY    TO
UNSIGNED        USERTYPE        ZONED
```

Note: All keywords must be in uppercase!

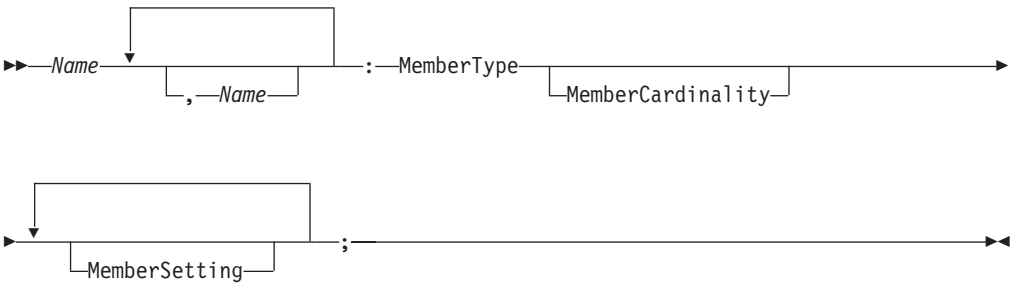
Structure definition:

Structure:



StructureSetting:

MemberDeclaration:



MemberType:

MemberCardinality:

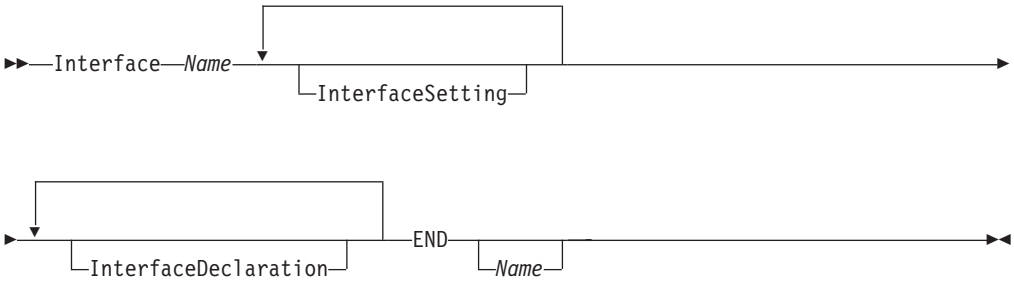
MemberSetting:

Note:

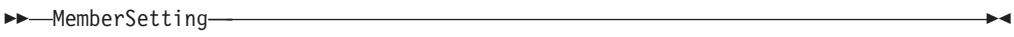
- Same syntax as structure definitions in FDL.

Interface definition:

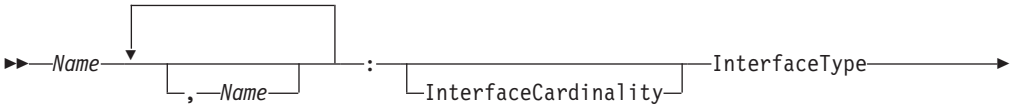
Interface:

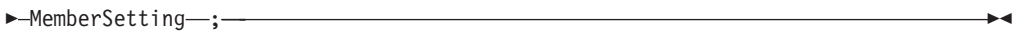


InterfaceSetting:

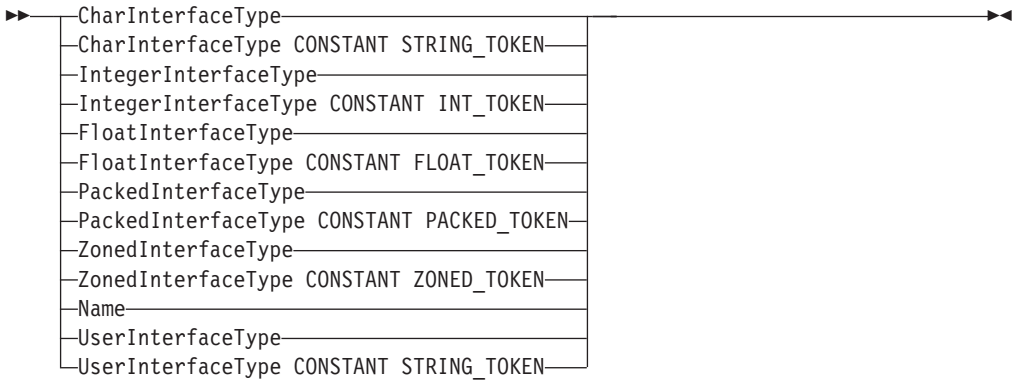


InterfaceDeclaration:

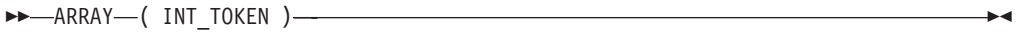




InterfaceType:



InterfaceCardinality:



Note:

- The sequence of elements is significant and defines the sequence of the elements in the data area used for forward and backward mapping. Each element has a fixed offset from the start of the data area. Make sure the interface elements have the size and type of the data the legacy application expects (See "Valid conversions between MQSeries Workflow container program mapping element types and program mapping interface types" on page 178 for size information).
- The sequence of member definitions in the structure is not relevant for the mapping. Mapping is done by name from interface elements to structure elements.

Interface types:

PackedInterfaceType:

PackedAttributeList:

Examples: p+212.2 equals 212.2, p-142.8 equals -142.8

Scale is used to define the decimal point of the packed number and the factor used by conversion. The packed number is multiplied by 10^{scale} in BACKWARDMAPPING and divided by 10^{scale} in FORWARDMAPPING. Of the plus character, minus character and unsigned character, only the lowermost 4 bits are used, which means that the value has to be <= x'0f'.

Example:
Packed number is 4711, scale is 0. Decimal number is 4711.
Packed number is 4711, scale is 2. Decimal number is 471100.
Packed number is 4711, scale is -2. Decimal number is 47.11.

Format: PACKED(5) SIGNED MINUS ″<h0d>″ PLUS ″<h0c>″ SCALE 1;

Byte0 Byte1 Byte2

DD DD DS

where D is a digit 0-9 and S is the positive or negative sign

Note:

- The size in bytes used by the packed number is (packed number size + 1) / 2, rounded up to the next integer.
- Packed numbers can create runtime conversion errors if the digits are > 9 or the sign does not match the sign defined for the interface element.

ZonedInterfaceType:

ZonedAttributeList:

Examples: z+471.1 equals 471.1, z-142.8 equals -142.8.

The size defines the number of significant digits used by the zoned number. Scale is used to define the decimal point of the zoned number and defines the factor used by conversion. The zoned number is multiplied by 10^{scale} in backward mapping and divided by 10^{scale} in forward mapping. FIRST and LAST define where the sign is located in the number. Of the plus character, minus character and unsigned character, only the lowermost 4 bits are used if the sign is not separate, which means the value has to be <= x'0f'. If the sign is separate, all 8 bits of the first character are used, which means the character has to be <= x'ff'. FIRST and LAST define the location of the sign (see examples below).

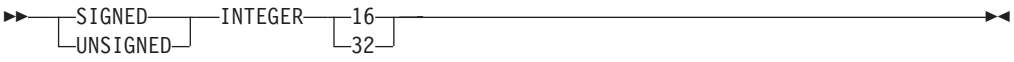
Example:
Zoned number is 4711, scale is 0. Decimal number is 4711.

Zoned number is 4711, scale is 2. Decimal number is 471100.
Zoned number is 4711, scale is -2. Decimal number is 47.11.
Format:
ZONED(3) SIGNED LAST LAST MINUS ″<h0d>″ PLUS ″<h0c>″ SCALE 2
Byte0 Byte1 Byte2
FD FD SD
where D is a digit 0-9 and S is the positive, negative or unsigned sign and F are the zoned bits.
Format:
ZONED(3) SIGNED FIRST LAST MINUS ″<h0d>″ PLUS ″<h0c>″ SCALE 2
Byte0 Byte1 Byte2
SD FD FD
where D is a digit 0-9 and S is the positive, negative or unsigned sign and F are the zoned bits.
Format:
ZONED(3) SIGNED LAST SEPARATE MINUS ″-″ PLUS ″+″ SCALE 2
Byte0 Byte1 Byte2 Byte3
FD FD FD XX
where D is a digit 0-9 and S is the positive, negative or unsigned sign and F are the zoned bits and XX is the sign (either x'4E' or x'60').

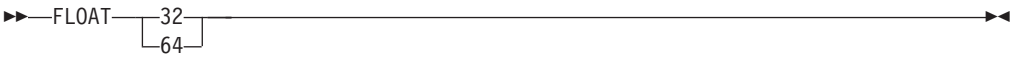
Note:

- The size in bytes used by the zoned number is the zoned number size. If the sign is separate, one additional byte is used.
- Zoned numbers can create runtime conversion errors if the digits are > 9 and the zone does not contain x'f' or the sign does not match the sign defined for the interface element.
- FIRST and LAST define where to append the sign.

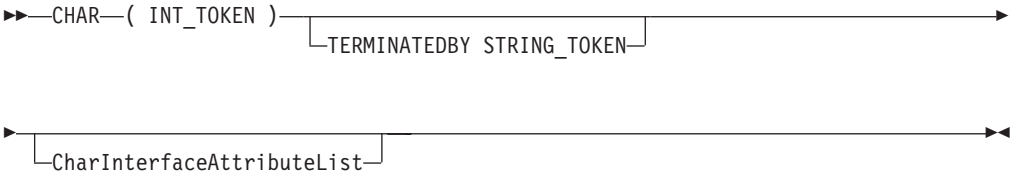
IntegerInterfaceType:



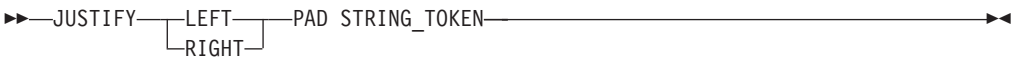
FloatInterfaceType:



CharacterInterfaceType:



CharInterfaceAttributeList:

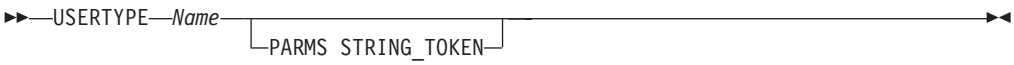


The termination character is inserted in forward mapping and stripped off in backward mapping. Padding, alignment and truncation occurs in forward mapping. The data is not modified in backward mapping. The character size in bytes must include the termination character and the number of bytes converted is one less than the specified character size.

Examples for justification:

Length	Content	Length	JUSTIFY(Left)	JUSTIFY(RIGHT)
3	'ABC'	4	'ABC '	' ABC'
3	'AB '	4	'AB '	' AB '
3	' BC'	4	' BC '	' BC'
4	'ABCD'	4	'ABCD'	'ABCD'
4	' BCD'	4	' BCD'	' BCD'
4	'ABC '	4	'ABC '	'ABC '
5	'ABCDE'	4	'ABCD'	'BCDE'
5	' BCDE'	4	' BCD'	'BCDE'
5	'ABCD '	4	'ABCD'	'BCD '

UserInterfaceType:

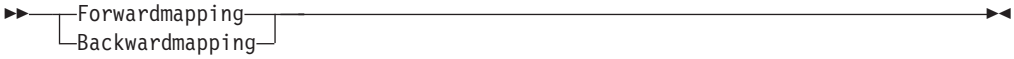


Note: STRING_TOKEN is passed to the usertype exit.

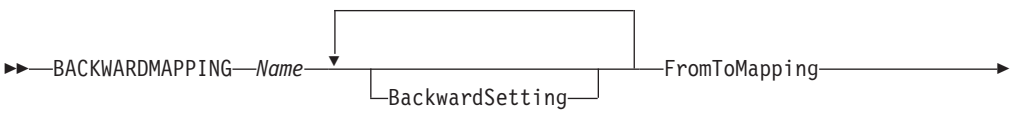
Mapping elements: This section illustrates the formal definition and grammar for the MDL. For each mapping element (structure, interface, forward/backward mapping etc.), there is a syntax diagram which explains how to use the elements correctly. Examples: “Example” on page 176ff and “MDL examples” on page 198ff.

MappingElement:

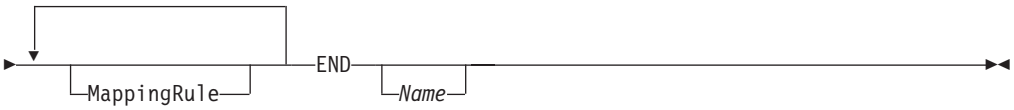
Mapping:



Backward mapping:



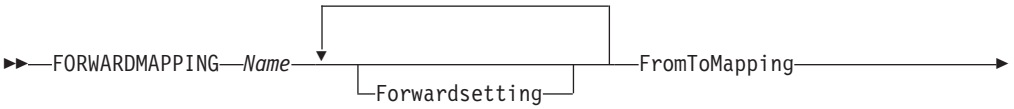
Program mapping

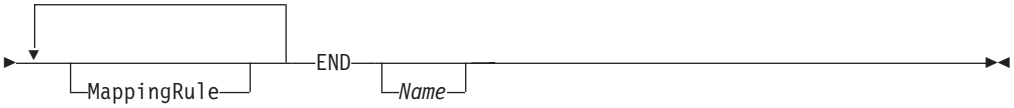


FromToMapping:

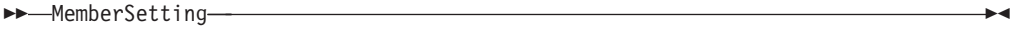
BackwardSetting:

Forward mapping:





ForwardSetting:

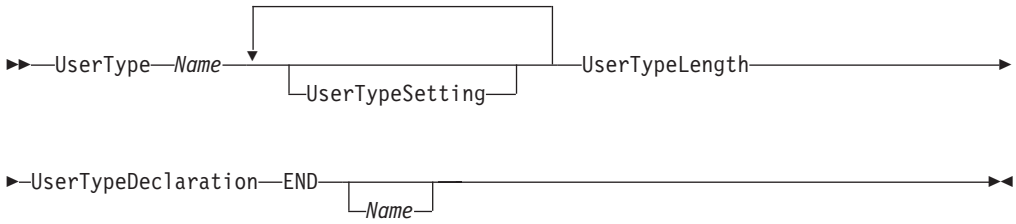


MappingRule:

Note: The first name must be the interface name in backward mapping and the structure element name in forward mapping. The second name must be the interface name in forward mapping and the structure element name in backward mapping (see "Mapping algorithm" on page 172

Usertype definition:

UserType:



UserTypeLength:

Note: The usertype length defines the size of the usertype in bytes.

UserTypeSetting:

UserTypeDeclaration:

Note: The first string_token in the usertype declaration defines the DLL name, and the second defines the exit entry name. It is therefore possible to use one DLL for multiple usertypes.

Sample MDL for C/C++ and COBOL: In this example, each definition is shown in detail and the variables used have the same name (interface and structure). Therefore the forward and backward mapping definitions are as simple as possible and an explicit mapping as in the previous example is unnecessary.

```
/*
   --- Structure definition ---
*/
STRUCTURE AccountRepStructureBackw
   LastName:  STRING;
   FirstName:  STRING;
   Zip: LONG;
   Salary: FLOAT;
   Tax: FLOAT;
   Customers: CustomerStructure [3];
END AccountRepStructureBackw
STRUCTURE AccountRepStructureForw
   LastName:  STRING;
   FirstName:  STRING;
   Zip: LONG;
   Salary: FLOAT;
   Tax: FLOAT;
END AccountRepStructureForw
/* In this example the CustomerStructure contains 3 elements
   (last name, first name and telephone number which are defined as
```

```
   string) */
STRUCTURE CustomerStructure
   LastName: STRING;
   FirstName: STRING;
   PhoneNumber: STRING;
END CustomerStructure
/*
   --- Interface definition for COBOL ---
*/
INTERFACE AccountRepInterfaceForCOBOL
        LastName: CHAR(50) JUSTIFY LEFT PAD ' ';
        FirstName: CHAR(50) JUSTIFY LEFT PAD ' ';
        Zip: UNSIGNED INTEGER 16;
        Salary: PACKED(8) UNSIGNED '<h0c>' SCALE -2;
        Tax: PACKED(2) UNSIGNED '<h0c>' SCALE -2;
        CustomersOpt: ARRAY(3) CustomerInterfaceForCOBOL;
END AccountRepInterfaceForCOBOL

INTERFACE CustomerInterfaceForCOBOL
        LastName: CHAR(50) JUSTIFY LEFT PAD ' ';
        FirstName: CHAR(50) JUSTIFY LEFT PAD ' ';
        PhoneNumber: CHAR(10) JUSTIFY LEFT PAD ' ';
END CustomerInterfaceForCOBOL
/*
   --- Interface definition for C++ ---
*/
INTERFACE AccountRepInterfaceForCpp
           LastName:  CHAR(50) TERMINATEDBY "<H00>" JUSTIFY LEFT PAD " ";
           FirstName: CHAR(50) TERMINATEDBY "<H00>" JUSTIFY LEFT PAD " ";
           Zip:       UNSIGNED INTEGER 16;
           Salary:    FLOAT 32;
           Tax:       FLOAT 32;
           Customers: ARRAY(3) CustomerInterfaceForCpp;
END AccountRepInterfaceForCpp
INTERFACE CustomerInterfaceForCpp
           LastName:    CHAR(50) TERMINATEDBY "<H00>" JUSTIFY LEFT PAD " ";
           FirstName:   CHAR(50) TERMINATEDBY "<H00>" JUSTIFY LEFT PAD " ";
           PhoneNumber: CHAR(10) TERMINATEDBY "<H00>" JUSTIFY LEFT PAD " ";
END CustomerInterfaceForCpp
/*
  -- Forward/backward mapping definition for COBOL ---
*/
FORWARDMAPPING ForwardSampleForCOBOL
    FROM AccountRepStructure TO AccountRepInterfaceForCOBOL
END ForwardSampleForCOBOL
BACKWARDMAPPING BackwardSampleForCOBOL
    FROM AccountRepInterfaceForCOBOL TO AccountRepStructure
END BackwardSampleForCOBOL
/*
 --- Forward/backward mapping definition for C++ ---
*/
FORWARDMAPPING ForwardSampleForCpp
    FROM AccountRepStructure TO AccountRepInterfaceForCpp
END ForwardSampleForCpp
BACKWARDMAPPING BackwardSampleForCpp
    FROM AccountRepInterfaceForCpp TO AccountRepStructure
END BackwardSampleForCpp
```

Note: This sample is distributed as FMCEMDL in SFMCDATA.

Usertype

A usertype allows converting MQSeries Workflow program mapping structure definition elements if the available interface types do not fulfill the required conversion. The program mapper will call a user exit each time a conversion for a usertype is required. It is possible to pass up to 256 characters to the user exit,

which must be defined where the interface element is mapped to the usertype. This allows using the same usertype for different conversions and controlling the functionality of the exit via passed parameters. In addition, it is possible to define parameters at the same time the forward and backward mapping formats are defined at buildtime. These are designated as 'forward mapping parameters' and 'backward mapping parameters', and the user exit has access to these parameters. Usertypes must have a fixed length.

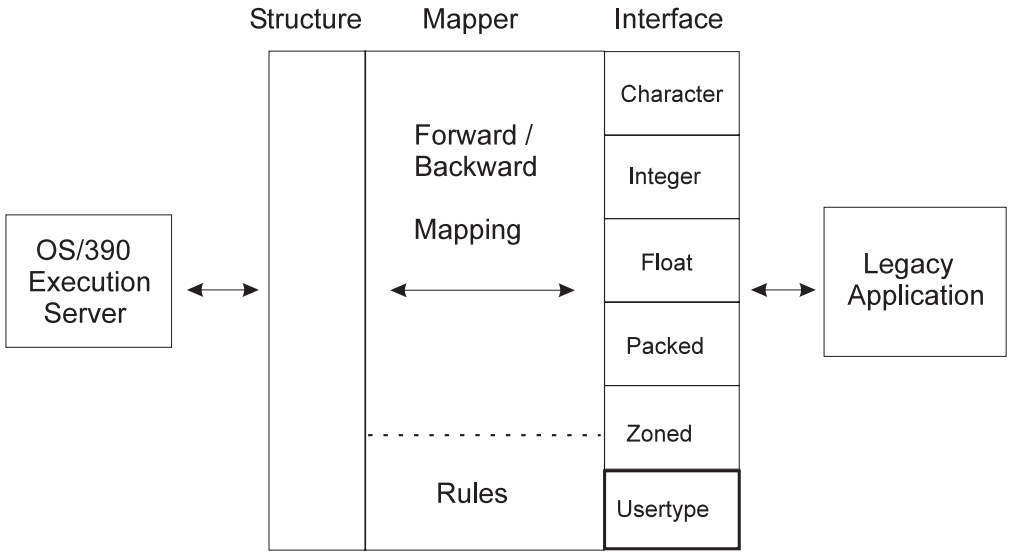


Figure 42. Usertype exit

Exit interface

The exit interface and data structures passed are defined in file fmcxmeut.h.

Note: The exit's entry point must have C linkage.

The following parameters are passed:

1. Direction of mapping required by PES

   Use defined constants to check whether forward or backward mapping should be done.

   ```
   #define FMC_PROGRAMMAPPING_USERTYPE_BACKWARDMAPPING 0
   #define FMC_PROGRAMMAPPING_USERTYPE_FORWARDMAPPING 1
   ```

2. InterfaceDescriptor

   Allows accessing the interface element data via a pointer to the data buffer. In addition the length of the usertype in bytes is passed.

   ```
   typedef struct {
           char* elementData;                  // pointer to raw data
           unsigned long elementDataLength;    // length of usertype in bytes
   } FmcProgrammMappingInterfaceDescriptor;
   ```

   Warning: Make sure that the data written into the data buffer during forward mapping is not longer than the size of the usertype in bytes. Otherwise the results can be unpredictable.

3. StructureDescriptor

Allows accessing the structure element. The element name and length are passed in addition to a handle to the MQSeries Workflow container. The element can be accessed with the MQSeries Workflow Container API by passing the element name.

```
typedef struct {
     const char* elementName;
        //container element name (zero terminated)
     unsigned long elementNameLength;
        // container element name length in bytes
     FmcjContainerHandle containerHandle;
        // container handle
} FmcProgrammMappingStructureDescriptor;
```

The element name contains the qualified element name and can be used to get or set the container element with the container API. The name is zero terminated.

4. BuildTimeParameter, buildTimeParameterLength

   At buildtime, it is possible to insert forward and backward mapping parameters. The length in bytes is passed via buildTimeParameterLength. The name is zero terminated.

5. InterfaceParameter, interfaceParameterLength

   It is possible to insert a parameter in the interface where the usertype is used. The length in bytes is passed via interfaceParameterLength. The name is zero terminated.

   Example:

```
INTERFACE SampleUsertypeInterface
       SampleElement: USERTYPE SampleUsertype PARMS "$";
END
```

6. Return value

   A nonzero return value signals an error to the program mapper and the return code is set for the activity implementation.

   For a sample, see sample usertype exit FMCHSMUT in SFMCDATA.

Creation of DLL

The usertype exit must be available at PES runtime. Any entry name and DLL name can be used, but these names must be identical to the names used in the usertype definition (See below). Sample JCL FMCHJMUT in SFMCDATA builds the sample usertype DLL. It is possible to have multiple usertype exits in one DLL if they use different function names.

Usertype definition

The usertype definition defines the name of a usertype and the length of the usertype in bytes. In addition the DLL name and exit function name have to be specified.

```
USERTYPE SampleUsertype LENGTH(4)
            DLL "SAMPUTY","SampleUsertypeExit"
END
```

See FMCHEMUT in SMFCDATA for a sample usertype definition.

Size of program mapping interface definition elements

The interface definition must match exactly the layout of the data the legacy application expects. If there is a mismatch of even one byte, the results are unpredictable!

The following list summarizes which number of bytes are used by the interface definition element types.

Table 15. Interface element size

Type	Length	Example
Char	Size equals length in bytes.	Char(2) has a length of 2 bytes.
Integer	2 bytes for INTEGER 16 and 4 bytes for INTEGER 32.	-
Float	4 bytes for FLOAT 32 and 8 bytes for FLOAT 64.	-
Packed	Size used to define the (packed number + 1) divided by 2 and rounded up	Packed(2) equals 2 bytes, Packed(3) equals 2 bytes and Packed(4) equals 3 bytes.
Zoned	Size used to define the zoned number if a separate sign is not defined. Otherwise, it is one larger than the size used to define the zoned number.	Zoned(4) equals 4 bytes as Zoned(4) SEPARATE equals 5 bytes.
UserType	Size of usertype.	USERTYPE SampleUsertype LENGTH(4) equals 4 bytes.

Note: If there is any alignment done by the compiler used to compile the legacy application, this alignment also must be done in the interface definition.

Example: A C structure defined as follows:

```
struct S {
          int x;
          char y;
          int z;
         };
```

might be aligned on 4-byte boundary so that

```
x x x x y       z z  z  z
0 1 2 3 4 5 6 7 8 9 10 11 Byte
```

and therefore needs following interface definition

```
INTERFACE i
          x:   SIGNED INTEGER 32;
          y:   CHAR(1) JUSTIFY LEFT PAD " ";
          pad: CHAR(3) JUSTIFY LEFT PAD "<h00>";
          z:   SIGNED INTEGER 32;
END
```

Activation of program mapping definitions

The activation of a program mapping definition is described in detail in "Administering program mapping" in *MQSeries Workflow for OS/390: Customization and Administration*. The following contains a short summary about how to activate a program mapping definition:

1. Copy sample job to FMCHJMPR.
2. Create an MDL.
3. Update control statements for the input utility.
4. Run and compile MDL and insert MDL into mapping database.
5. If existing MDL elements were modified, restart the PES to activate the modifications. For new elements, no PES restart is needed.

Troubleshooting

In order to provide as much help to you as possible, this section lists usual problems and typical solutions. For a detailed list of error messages refer to *MQSeries Workflow for OS/390: Messages and Codes*.

Common errors

Element data mapped is incorrect: Most commonly, this is due to a mismatch between the legacy application data layout and the interface definition.

There is no way for the program mapper to check whether the interface maps correctly to the data format and layout the legacy application expects. Each interface should be carefully created and double checked. Runtime conversion errors (for packed and zoned interface types), are usually caused by this. In addition, reflect alignment on the legacy side in the interface (see "Size of program mapping interface definition elements" on page 194 for more details). If the size of one interface element is incorrect (for example integer 16 instead of integer 32) all the following data will be incorrect.

Elements not mapped: Either the element names are different and no mapping rule was specified or a mapping rule uses the wrong element names.

Note: If a mapping rule is used in both directions, the mapping rule arguments have to be switched.

Modified mapping definition is not activated: Mapping definitions are reloaded whenever the PES is restarted. It is not sufficient to import the definition into the program mapping database. New definitions will be used without a PES restart.

Additional mapping examples

Application examples

CICS C++ Application: This C++ application under CICS displays the data, creates new customers and increases the salary by 8 percent. It corresponds to the forward/backward mapping example in "Forward/backward mapping definition" on page 170.

```
#pragma XOPTS(SP)
#include <iostream.h>
#include <stdio.h>
#include <stdlib.h>
/* --- CustomerStructure --- */
#pragma pack(1)
struct CustomerStructure {
   char LastName[50];
   char FirstName[50];
   char PhoneNumber[10];
};
/* --- AccountRepStructure --- */
struct AccountRepStructure {
   char LastName[50];
   char FirstName[50];
   short Zip;
   float Salary;
   float Tax;
   struct CustomerStructure Customers[3];
};
#pragma pack(1)
int main()
```

```
{
   struct AccountRepStructure *commarea;
   EXEC CICS ADDRESS COMMAREA(commarea) EIB(dfheiptr);
   if (dfheiptr->eibcalen <= 0) {
      cout << "??? Empty commarea ???" << endl;
      EXEC CICS RETURN;
   }
// Display all data
   cout << "LastName:   " << commarea->LastName << endl;
   cout << "FirstName:  " << commarea->FirstName << endl;
   cout << "Zip:        " << commarea->Zip << endl;
   cout << "Salary:     " << commarea->Salary << endl;
   cout << "Tax:        " << commarea->Tax << endl;
// Create customers
   strcpy(commarea->Customers[0].LastName,"EINSTEIN");
   strcpy(commarea->Customers[0].FirstName,"ALBERT");
   strcpy(commarea->Customers[0].PhoneNumber,"3048");
   strcpy(commarea->Customers[1].LastName,"NEWTON");
   strcpy(commarea->Customers[1].FirstName,"ISAAC");
   strcpy(commarea->Customers[1].PhoneNumber,"4041");
   strcpy(commarea->Customers[2].LastName,"HAWKING");
   strcpy(commarea->Customers[2].FirstName,"STEVEN");
   strcpy(commarea->Customers[2].PhoneNumber,"5154");
   for (int i=0; i<3; i++) {
      cout << "Customer LastName : "
         << commarea->Customers[i].LastName << endl;
      cout << "Customer FirstName : "
         << commarea->Customers[i].FirstName << endl;
      cout << "Customer PhoneNumber : "
         << commarea->Customers[i].PhoneNumber << endl;
   }
// Increase salary by 8%
   commarea->Salary *= 1.08;
   cout << "New Salary: " << commarea->Salary << endl;
   EXEC CICS RETURN;
}
```

CICS COBOL Application: This COBOL application under CICS does the same thing as "CICS C++ Application" on page 196 (displays the data, creates new customers and increases the salary by 8 percent). It corresponds to the forward/backward mapping example in "Forward/backward mapping definition" on page 170.

```
       IDENTIFICATION DIVISION.
       PROGRAM-ID. "SAMPCBL".
       DATA DIVISION.
         WORKING-STORAGE SECTION.
         01 PRINT-SALARY PIC Z(5)9.9(2).
         01 PRINT-TAX PIC Z9.99.
         LINKAGE SECTION.
         01  DFHCOMMAREA.
      *
      *     AccountRepStructure
      *
              02  LASTNAME PIC X(50).
              02  FIRSTNAME PIC X(50).
              02  ZIP  PIC 9999 COMP-4.
              02  SALARY PIC 9(6)V9(2) COMP-3.
              02  TAX PIC V99 COMP-3.
      *
      *     CustomerStructure
      *
              02  CUSTOMERS OCCURS 3 TIMES
                     INDEXED BY CUSTOMER-INDEX.
                 03 LAST-NAME PIC X(50).
                 03 FIRST-NAME PIC X(50).
                 03 PHONE-NUMBER PIC X(10).
```

```
 PROCEDURE DIVISION.
      IF EIBCALEN <= 0
         DISPLAY "??? EMPTY COMMMAREA ???"
         EXEC CICS RETURN
         END-EXEC
      END-IF
*
*     Display all data
*
      DISPLAY "Lastname:  " LASTNAME
      DISPLAY "Firstname: " FIRSTNAME
      DISPLAY "Zip:       " ZIP
      MOVE TAX TO PRINT-TAX
      MOVE SALARY TO PRINT-SALARY
      DISPLAY "Salary:    " PRINT-SALARY
      DISPLAY "Tax:       " PRINT-TAX
*
*     Create some customers
*
      MOVE "EINSTEIN" TO LAST-NAME(1)
      MOVE "ALBERT" TO FIRST-NAME(1)
      MOVE "3048" TO PHONE-NUMBER(1)
      MOVE "NEWTON" TO LAST-NAME(2)
      MOVE "ISAAC" TO FIRST-NAME(2)
      MOVE "4041" TO PHONE-NUMBER(2)
      MOVE "HAWKING" TO LAST-NAME(3)
      MOVE "STEPHEN" TO FIRST-NAME(3)
      MOVE "5154" TO PHONE-NUMBER(3)
      PERFORM
         VARYING CUSTOMER-INDEX FROM 1 BY 1
            UNTIL CUSTOMER-INDEX > 3
         DISPLAY "Customer LastName : "
            LAST-NAME(CUSTOMER-INDEX)
         DISPLAY "Customer FirstName: "
            FIRST-NAME(CUSTOMER-INDEX)
         DISPLAY "Customer PhoneNumber: "
            PHONE-NUMBER(CUSTOMER-INDEX)
      END-PERFORM
*     Increase salary by 8%
      COMPUTE SALARY = SALARY * 1.08
      MOVE SALARY TO PRINT-SALARY
      DISPLAY "New Salary: " PRINT-SALARY
      EXEC CICS RETURN
      END-EXEC
      GOBACK.
```

MDL examples

This section illustrates some examples of how to use the mapper. There are examples coded in C, COBOL and for simple and complex data structures.

Simple data structure with default name mapping: In this example the mapping is defined for a simple data structure and the mapping used is the default one (which means that each element of a container is mapped to the element with the **same name** in the other container).

```
STRUCTURE SimpleDataStructure
        element1: STRING;
        element2: STRING;
        element3: LONG;
        element4: FLOAT;
        element5: BINARY;
        element6: BINARY;
        element7: LONG(20);
        END SimpleDataStructure
INTERFACE SimpleDataInterface
        DESCRIPTION 'This is an example of a simple interface mapping'
```

```
        element1: CHAR(10) TERMINATEDBY "<h00>" JUSTIFY LEFT PAD ' ';
        element2: CHAR(20) JUSTIFY LEFT PAD "<h00>";
        element3: SIGNED INTEGER 16;
        element4: FLOAT IBM 32;
        element5: CHAR(500);
        element6: CHAR(200);
        element7: ARRAY (10) SIGNED INTEGER 8;
        END SimpleDataInterface
BACKWARDMAPPING SimpleMapping
        FROM SimpleDataInterface
        TO SimpleDataStructure
        END SimpleMapping
FORWARDMAPPING SimpleMapping
        FROM SimpleDataStructure
        TO SimpleDataInterface
        END SimpleMapping
```

Complex data structure with default name mapping: In this example, the mapping is defined for a complex data structure and the mapping used is the default one (which means that each element of a container is mapped to the element with the **same name** in the other container).

```
STRUCTURE ComplexDataStructure1
        element1: STRING (10);
        element2: FLOAT;
        END ComplexDataStructure1
STRUCTURE ComplexDataStructure2
        element1: STRING (20);
        element2: ComplexDataStructure (5);
        END ComplexDataStructure2
INTERFACE ComplexDataInterface1
        element1: CHAR(10) TERMINATEDBY "<h00>" JUSTIFY LEFT PAD ' ';
        element2: FLOAT IBM 32";
        END ComplexDataInterface1
INTERFACE ComplexDataInterface2
        element1: CHAR(20) JUSTIFY RIGHT PAD ' ';
        element2: ARRAY(5) ComplexDataInterface1;
        END ComplexDataInterface2
BACKWARDMAPPING ComplexMapping
        FROM ComplexDataInterface2
        TO ComplexDataStructure2
            /*
             * Element1 and element2 are mapped implicitly
             */
        END ComplexMapping
FORWARDMAPPING ComplexMapping
        FROM ComplexDataStructure2
        TO ComplexDataInterface2
            /*
             * element1 and element2 are mapped implicitly
             */
        END ComplexMapping
```

Complex data structure with non-default name mapping: In this example the mapping is defined for a complex data structure and the mapping used is not the default one (which means that the structure elements of ComplexDataStructure1 do not have identical names in the interface ComplexStructure1 and are mapped explicitly).

```
STRUCTURE ComplexDataStructure1
        strs: STRING (10);
        flts: FLOAT;
        END ComplexDataStructure1
INTERFACE ComplexDataInterface1
        stri: CHAR(10) TERMINATEDBY "<h00>" JUSTIFY LEFT PAD ' ';
        flti: FLOAT IBM 32;
```

```
        END ComplexDataInterface1
BACKWARDMAPPING ComplexMapping
        FROM ComplexDataInterface1
        TO ComplexDataStructure1
           MAP stri TO strs;
           MAP flti TO flts;
        END ComplexMapping
FORWARDMAPPING ComplexMapping
        FROM ComplexDataStructure1
        TO ComplexDataInterface1
           MAP strs TO stri;
           MAP flts TO flti;
        END ComplexMapping
```

Complex data structure with non-default name mapping with arrays and structures: In this example, the mapping is defined for a complex data structure and the mapping used is not the default one (which means that the elements (in this case arrays) of structure ComplexDataStructure1 do not have identical names in the Interface ComplexStructure1 and are mapped explicitly).

```
STRUCTURE ComplexDataStructure1
        element1: STRING (10);
        element2: FLOAT;
        END ComplexDataStructure1
STRUCTURE ComplexDataStructure2
        element1: STRING (20);
        element2: ComplexDataStructure1 (5);
        specials: FLOAT;
        END ComplexDataStructure2
STRUCTURE ComplexDataStructure3
        element1: STRING (5);
        element2: ComplexDataStructure2 (4);
        element3: ComplexDataStructure1 (4);
        END ComplexDataStructure3
INTERFACE ComplexDataInterface1
        element1: CHAR(10) TERMINATEDBY "<h00>" JUSTIFY LEFT PAD ' ';
        element2: FLOAT IBM 32;
        END ComplexDataInterface1
INTERFACE ComplexDataInterface2
        element1: CHAR(20) TERMINATEDBY "<h00>" JUSTIFY RIGHT PAD '*';
        element2: ARRAY (5) ComplexDataInterface1;
        speciali: FLOAT IBM 32
        END ComplexDataInterface2
INTERFACE ComplexDataInterface3
        element1: CHAR(5) JUSTIFY RIGHT PAD '*';
        element2: ARRAY (4) ComplexDataInterface1;
        elementx: ARRAY (4) ComplexDataInterface2;
        END ComplexDataInterface3
BACKWARDMAPPING ComplexMapping
        FROM ComplexDataInterface3
        TO ComplexDataStructure3
         /* Interface element elementx is explicitly mapped to structure
            element element2. All structure and interface elements of this
            structure are mapped per default; interface element element2 is
            also explicitly mapped with all its subelements. */
           MAP 'elementx' to 'element2';
           MAP 'element2' to 'element3';
           /* element speciali is not mapped per default and an explicit rule
              for this element is required */
           MAP 'elementx.speciali' to 'element2.specials';
           /* Per default mapping element1 with all subelements is mapped */
END ComplexMapping
FORWARDMAPPING ComplexMapping
        FROM ComplexDataStructure1
        TO ComplexDataInterface1
         /* Structure element element2 is explicitly mapped to interface
            element elementx. All structure and interface elements of this
```

```
          structure are mapped per default; structure element element3 is
          also explicitly mapped with all its subelements. */
         MAP 'element2' to 'elementx';
         MAP 'element3' to 'element2';
         /* element specials is not mapped per default and an explicit rule
            for this element is required */
         MAP 'element2.specials' to 'elementx.speciali';
         /* Per default mapping element1 with all subelements is mapped */
      END ComplexMapping
```

Simple data structure with all interface types with CONSTANTS and usertypes: In this example the mapping is defined for a simple data structure and the mapping used is not the default one (which means that the elements of structure ComplexDataStructure1 do not have identical names in the interface ComplexStructure1 and are mapped explicitly). Additionally, there is a usertype defined, which converts a 4 byte integer into a Workflow string, separates every three digits by a comma and prefixes the string with a currency symbol, for example $1,234,567.

```
/* A usertype which converts a 4 byte integer into a Workflow string, separates
 * every three digits by a comma and prefixes the string with a currency
 * symbol, for example $1,234,567 */
USERTYPE user1 LENGTH(4)
               DLL "dlluser","user2Inbound"
        END user1
STRUCTURE SimpleDataStructure
        element1: LONG;
        element2: STRING;
        element3: LONG;
        element7: LONG(20);
        element8: STRING;
        END SimpleDataStructure
INTERFACE SimpleDataInterface
        DESCRIPTION 'This is an example of a simple interface mapping'
        /* The following integer constant is inserted in forward mapping
         * and removed in backward mapping */
        insert:   SIGNED INTEGER 16
                  CONSTANT 4711
        element3: SIGNED INTEGER 16;
        element7: ARRAY (100) SIGNED INTEGER 8;
        element1: USERTYPE user1 PARMS 'DM'; /* three digits */
        element8: USERTYPE user1 PARMS '$'; /* for example $12,345 */
        element9: CHAR(5) CONSTANT "This is a string constant with some
                        hex chars <h47><h11>" JUSTIFY RIGHT PAD '*'
        element10: PACKED (10) CONSTANT p47.11
                        SIGNED FIRST MINUS "<h0d>" PLUS "<h0c>" UNSIGNED "<h0c>"
                        SCALE 5
        element11: ZONED (10) CONSTANT z47.11
                        SIGNED FIRST MINUS "<h0d>" PLUS "<h0c>" SCALE 5
        element12: FLOAT IBM 8
                   CONSTANT +47E11
        END SimpleDataInterface
BACKWARDMAPPING SimpleMapping
        FROM SimpleDataInterface
        TO SimpleDataStructure
        END SimpleMapping
FORWARDMAPPING SimpleMapping
        FROM SimpleDataStructure
        TO SimpleDataInterface
        END SimpleMapping
```

Program execution server exits

Introduction

For extensibility of MQSeries Workflow for OS/390, the PES uses exits in the following areas:

- Application invocation
- Legacy application program mapping
- Event notification

Whenever new exits are needed, these exits can be used instead of, or in parallel with, the IBM supplied exits.

The exits have a defined interface, to which every user written exit must conform.

Each exit type must provide an **Init()** function, which is called from the PES when the exit is needed the first time. Later, the exit-specific functions are called (see the specific exit descriptions for more details). A shutdown request for the PES triggers a call to the **Deinit()** function of the exits.

Usually the **Init()** function does all the initialization needed for the exit. If information is needed further on in subsequent calls, a handle can be filled in the initialization call, which is then passed to all subsequent functions (for example, DB handles, connection information, states, etc.). **Deinit()**, which is called last, normally deallocates and frees all resources allocated during Init().

The exit DLL is loaded by the PES when the exit is needed the first time and unloaded when the PES terminates.

The main difference between the exit types is the following:

- **Mapping** exits do a data conversion between MQSeries Workflow for OS/390 containers and data acceptable by legacy applications.
- **Invocation** exits invoke applications on the application side.
- **Notification** exits react to specific events reported by the PES in conjunction with program invocation requests.

Notes:

1. Whenever you modify an exit, you must shutdown and reboot the PES in order to make your changes effective.
2. All PES exits must be reentrant.

Return codes and error messages

All exits use a return code to signal availability of error information from the exit functions to the PES. If the return code is not OK, 4 parameters used in each function contain more detailed error information. The possibility exists to classify errors as recoverable or non-recoverable. The PES no longer distinguishes between these two types of errors. Both are handled the same way: by passing the error to the execution server for a Workflow request or in the case of an Execute Program request issued by a Workflow client.

Parameters:

char * errorIdBuffer

- 4-character buffer provided by the PES and used to pass an error number. Must be set accordingly if the ID is shorter than 4 characters.

- Input/output parameter

long * errorIdBufferLength

- Length of the message number in errorIdBuffer, which must be set by the exit. The maximum available number of characters is specified. Valid lengths are between 0 and the value passed in errorIdBufferLength.
- Input/output parameter

char * errorDescriptionBuffer

- Character buffer provided by the PES, which is 512 characters long and is used for an error message. Has to be set accordingly if the message is shorter than 512 characters.
- Input/output parameter

long * errorDescriptionBufferLength

- Length of the description in errorDescriptionBuffer, which must be set by the exit. The maximum available number of characters is passed. Valid lengths are between 0 and the value passed in errorDescriptionBufferLength.
- Input/output parameter

The error ID can consist of up to 4 digits. The PES prefixes it with a character identifying the exit type (I for invocation, M for mapping, N for notification). In addition the errorDescription is prefixed by the PES with the DLL name of the exit so that each exit can use the message numbers and the DLL name is the identifier of the exit.

Return codes:

FMC_EXIT_OK
The function was successful.

FMC_EXIT_RECOVERABLE_ERROR
The function was unsuccessful but recoverable. The PES will return message FMC32204 (see *MQSeries Workflow for OS/390: Messages and Codes*) with the passed error information. The PES continues processing. errorIdBuffer, errorIdBufferLength, errorDescriptionBuffer, and errorDescriptionBufferLength must be set accordingly .

FMC_EXIT_NONRECOVERABLE_ERROR
The function was unsuccessful and unrecoverable. The PES handles this error similar to recoverable errors.

Interfaces for all exits

Note: All interfaces must have C linkage!

Init()

Header files: FMCXMIF.H (program mapping exit), FMCXIEP.H (invocation exit), FMCXNEIF.H (notification exit).

Function:

- Initialize exit.
- It is called once when the exit is used the first time.

Interface:

```
long Init
   ( void **  exitHandle,
     void *   initializationParameter,
     long     initializationParameterLength,
     char *   errorIdBuffer,
     long *   errorIdBufferLength,
     char *   errorDescriptionBuffer,
     long *   errorDescriptionBufferLength)
```

Parameters:

void ** exitHandle

- Pointer passed to the **Init()** function, which is not used by the PES but passed to any function called at a later time. Used to pass exit environment data between the PES and all exit functions.
- Input/output parameter

void * initializationParameter

- Parameters defined in the PES directory entry for the exit, which can be used to customize the exit initialization. The parameter is terminated by zero.
- Input parameter

long initializationParameterLength

- Length of the initializationParameter in bytes.
- Input parameter

char * errorIdBuffer

- See "Return codes and error messages" on page 202 for detailed information.

long * errorIdBufferLength

- See "Return codes and error messages" on page 202 for detailed information.

char * errorDescriptionBuffer

- See "Return codes and error messages" on page 202 for detailed information.

long * errorDescriptionBufferLength

- See "Return codes and error messages" on page 202 for detailed information.

Return codes: See "Return codes and error messages" on page 202 for the return codes.

Deinit()

Header files: FMCXMIF.H (program mapping exit), FMCXIEP.H (invocation exit), FMCXNEIF.H (notification exit).

Function:

- Deinitialize exit.
- It is called once when the PES terminates.

Interface:

```
long Deinit
 ( void **  exitHandle,
   char *   errorIdBuffer,
   long *   errorIdBufferLength,
   char *   errorDescriptionBuffer,
   long *   errorDescriptionBufferLength)
```

Parameters:

void ** exitHandle

- Pointer passed to the **Init()** function, which is not used by the PES but passed to any function called later on. Used to pass exit environment data between the PES and all exit functions.
- Input/output parameter

char * errorIdBuffer

- See "Return codes and error messages" on page 202 for detailed information.

long * errorIdBufferLength

- See "Return codes and error messages" on page 202 for detailed information.

char * errorDescriptionBuffer

- See "Return codes and error messages" on page 202 for detailed information.

long * errorDescriptionBufferLength

- See "Return codes and error messages" on page 202 for detailed information.

Return codes: See "Return codes and error messages" on page 202 for the return codes.

Special considerations for exit programming

Use of RRS commit and rollback

PES exits are called in the context of an MQSeries Workflow transaction by the program execution server (PES). Changes made by the exits can be made persistent (RRS commit) or rescinded (RRS rollback). However, these actions also terminate the transaction itself. Since PES exits can be called at any point during the transaction, RRS commit or rollback would terminate the transaction prematurely and lead to unpredictable results. In particular, a ″safe application″ would no longer be ″safe″.

Consequently, RRS commit and rollback calls **srrcmit** and **srrback** must never be issued in a PES exit. Furthermore, any functions performing these calls must *not* be used in PES exits; otherwise, units of work are terminated by these calls before the PES can complete them.

Buffer allocation

Both invocation and mapping exits use buffers to receive data from the PES and pass data to the PES. In some situations, the buffers are owned by the PES and must not be deleted by the exit. In other situations, the buffers must be created and deleted by the exit. For specific requirements, see the descriptions of the individual buffer parameters.

Program mapping exit

The IBM-supplied program mapping exit can be used to convert and translate data between legacy applications and MQSeries Workflow for OS/390. Any other mapping exit that conforms to the mapping exit interface can be used in parallel with, or in place of, the IBM supplied mapping exit.

The program mapping exit must be available in a DLL which is loaded by the PES and used to translate the MQSeries Workflow for OS/390 container data into data accepted by a legacy application.

A mapping exit must follow the general rules for PES exits as described in "Interfaces for all exits" on page 203. The DLL must have two exit functions: **Init()** and **Deinit()** and one exit specific function **Translate()**. The latter is used to do the actual conversion and translation for forward and backward mappings every time a legacy application is called. The raw buffer for the legacy application is available, and the container can be accessed via MQSeries Workflow for OS/390 Container API calls.

In forward mapping calls, the program mapping exit must extract the data from the container and translate the data into a raw buffer which is passed to the legacy application. In backward mapping calls the program mapping exit must translate the raw buffer and assign the data to the container.

Additional interfaces specific to the program mapping exit

The program mapping exit must define the **Translate()** function as follows.

Translate()

Header files: FMCXMIF.H (program mapping exit).

Function:

- **Translate()** is called each time by the PES in the direction FMC_PROGRAMMAPPING_BACKWARDMAPPING when backward mapping is to be done and in the direction FMC_PROGRAMMAPPING_FORWARDMAPPING when forward mapping is to be done.

Interface:

```
long Translate
  (void *  exitHandle,
   short   direction,
   char *  mappingName,
   long    mappingNameLength,
   char *  buildTimeParameter,
   long    buildTimeParameterLength,
   void *  containerHandle,
   char ** buffer,
   long *  bufferLength,
   char *  errorIdBuffer,
   long *  errorIdBufferLength,
   char *  errorDescriptionBuffer,
   long *  errorDescriptionBufferLength)
```

Parameters:

void * exitHandle

- Pointer passed to the **Init()** function, which is not used by the PES but passed to any function called at a later time. Used to pass exit environment data between the PES and all exit functions.
- Input/output parameter

short direction

- Used to identify the translation direction. Either FMC_PROGRAMMAPPING_BACKWARDMAPPING or FMC_PROGRAMMAPPING_FORWARDMAPPING
- Input parameter

char * mappingName

- Forward mapping format or backward mapping format defined in the OS/390 program properties. The name is zero terminated.
- Input parameter

long mappingNameLength

- Length of the mappingNameLength in bytes.
- Input parameter

char * buildTimeParameter

- Forward mapping parameter or backward mapping parameter defined in the OS/390 program properties. Can be used to customize the translation process. The parameter is zero terminated.
- Input parameter

long buildTimeParameterLength

- Length of the buildTimeParameter in bytes.
- Input parameter

void * containerHandle

- Handle to the MQSeries Workflow for OS/390 container used for translation. Argument in MQSeries Workflow for OS/390 Container API calls to access the container.
- Input parameter

char ** buffer

- Pointer to a valid buffer address for forward mapping calls. It must be set by the program mapping exit to point to a valid buffer address in backward mapping calls. This buffer is passed by the PES to the legacy application in forward mapping calls and to the program mapping exit for data conversion and setting of container elements in backward mapping calls.
- Input parameter for forward mapping. The buffer is created and owned by the exit and passed to the PES.
- Output parameter for backward mapping. The buffer is created and owned by the PES and passed to the exit.

long * bufferLength

- Pointer to the length of the buffer in bytes. This is already set in forward mapping calls and must be set in backward mapping calls by the program mapping exit.
- Input parameter for forward mapping
- Output parameter for backward mapping

char * errorIdBuffer

- See "Return codes and error messages" on page 202 for detailed information.

long * errorIdBufferLength

- See "Return codes and error messages" on page 202 for detailed information.

char * errorDescriptionBuffer

- See "Return codes and error messages" on page 202 for detailed information.

long * errorDescriptionBufferLength

- See "Return codes and error messages" on page 202 for detailed information.

Return codes: See "Return codes and error messages" on page 202 for the return codes.

See the program mapping sample "Program mapping exit example" for more details.

Enabling the PES to use a program mapping exit

In order to use a program mapping exit, the exit must reside in a DLL which must be available in a link library used by the PES. Customize the sample JCL FMCHJMEX in *InstHLQ*.SFMCCNTL and submit the job.

You must then notify the PES of the program mapping exit by defining it in the PES directory. See *MQSeries Workflow for OS/390: Customization and Administration* for more information.

Program mapping exit example

A C sample program mapping exit (FMCHSMEX in *InstHLQ*.SFMCSRC) with a corresponding JCL to compile and link the exit (FMCHJMEX in *InstHLQ*.SFMCCNTL).

The sample exit gives an example how a program mapping exit should work in general. It also shows how the exit can use all the different parameters passed (exit initialization parameter, forward/backward mapping format and forward/backward mapping parameters), how error messages can be created and how the container elements can be accessed.

The exit can convert MQSeries Workflow for OS/390 container elements of type LONG and FLOAT into C types long and double. The elements are converted in the same sequence that the elements are defined in the container structure.

The type of the element is derived from the first character of the element name and must be defined in the PES directory entry for the mapping exit (exitParameters).

ExitParameter syntax: LONG=x FLOAT=y

where x is the character used to identify LONG container elements and y is the character to identify FLOAT container elements. All elements starting with an undefined character are ignored.

In addition TRACE=YES can be defined during initialization to enable trace printouts.

Mapping example:

```
STRUCTURE S
   LE1: LONG(2);
   FE1: FLOAT;
   LE2: LONG;
END;
```

will be converted so that the following structure is filled with conversion data:

```
struct S {
   long LE1[2];
   double FE1;
   long LE2;
};
```

The following three different mapping formats are available:

1. DEFAULT
2. INCREASE_INCOME
3. DECREASE_INCOME

The first format does normal conversion of the values. The second one increases all values by 8% (default), while the third format decreases all values by 8% (default). If other percentages are needed, they can be defined as forward mapping parameters or backward mapping parameters using the Buildtime tool when the program properties for OS/390 are defined.

To use the mapping sample, you must

1. Compile and link the mapping sample (See JCL FMCHJMEX in *InstHLQ*SFMCCNTL).
2. Update the PES directory with following definition (see "Importing a PES directory source file" in *MQSeries Workflow for OS/390: Customization and Administration*).

   (KEYTOMAPPING2)

   ```
   type           =SAMPLE
   exitName       =SAMPEXT
   exitParameters =LONG=L FLOAT=F
   ```
3. Define a program in BuildTime that uses the sample mapping type SAMPLE and optionally provides a different increase/decrease amount for forward/backward mapping parameters.

Program invocation exit

A program invocation exit is used by the program execution server to run a requested application on a service system like CICS or IMS. The corresponding invocation request is issued to the program execution server by an MQSeries Workflow for OS/390 execution server.

To handle an invocation request, the program execution server uses an exit containing the implementation of an invocation type such as *EXCI*. This allows application developers using MQSeries Workflow for OS/390 to attach their own invocation types to MQSeries Workflow for OS/390. An invocation exit must follow the general rules for program execution server exits as described in “Program execution server exits” on page 202 in this book. As for all program execution server exits, invocation exits are available as dynamic link libraries providing entry points.

Synchronous and asynchronous invocation exits

MQSeries Workflow for OS/390 supports synchronous and asynchronous invocation exits. They are characterized by the following. Asynchronous invocations must be based on MQSeries queues.

Synchronous invocation exit: A synchronous invocation exit

- establishes the connection to the service where the request should run.
- runs the requested application on that service by use of the invocation protocol.
- removes the connection to the service after the application has terminated.
- passes back the output data from the application, or an error message if the invocation failed, to the program execution server.
- if, depending on the invocation protocol, connections can be reused by subsequent calls, the connections are cached after being used a first time and removed at deinitialization of the invocation exit.

The program execution server ″waits″ for the output from a synchronous invocation exit.

Asynchronous invocation exit: When processing a request, the program execution server calls an asynchronous invocation exit twice. First to handle a request, and second to handle a reply. If an asynchronous invocation exit is called by the program execution server with parameters describing a request, it does not execute a request from the program execution server directly on the target service system. It only creates a message consisting of an invocation specific header followed by the data for the requested application and passes it back to the program execution server. It also creates a message descriptor (which is an MQSeries message descriptor MQMD since only MQSeries based invocations are supported) and passes it back also.

The program execution server then uses the message descriptor and message together with the connection parameters to put the message to the input queue as specified by the connection parameters. The program execution server does not wait until the requested application has finished but rather continues with the next request.

When the program execution server gets the reply message consisting of message descriptor and message data, it calls the respective invocation exit to recognize the reply message. It is recommended that only asynchronous invocation protocols be used for which the message contains protocol-specific data at the beginning, for example CICS bridge header MQCIH or IMS bridge header MQIIH, so that the reply can be correctly handled by the invocation exit. Also, it is recommended to reflect that format in the message descriptor (by the Format field in the MQMD structure).

If an exit recognizes the reply, it is called to handle it and passes the application output data, or an error message, back to the program execution server.

Note: An asynchronous invocation exit does **not** connect itself to a service. The MQSeries queues to and from the service are always served by the PES.

Additional interfaces specific to the invocation exit

Each asynchronous and synchronous invocation exit must provide the following additional entry points beside the interfaces provided by all program execution server exits:

HdlRequ()

Header files: FMCXIEP.H (invocation exit).

Function:

- For a synchronous invocation, this method executes an application program passed as **executableName** on a service to which it connects as defined by *connectionParameters*. If no error occurs, this function returns the output from the application in a buffer passed back by the **programOutput** parameter.
- For an asynchronous invocation this method either creates a request message or treats the passed parameters as a reply message. The parameters represent a request message if an application name is passed as **executableName**. If zero is passed as **executableName**, the parameters represent a reply message whose data is passed as **executableParameters** and **executableParametersLength** together with a message descriptor MQMD as **messageDescriptor** and **messageDescriptorLength**.

Interface:

```
long HdlRequ
   (void *  exitHandle,
    void *  invocationContext,
    char *  serviceName,
    long    serviceNameLength,
    char *  connectionParameters,
    long    connectionParametersLength,
    char *  executableName,
    long    executableNameLength,
    char *  executableType,
    long    executableTypeLength,
    char *  executionParameters,
    long    executionParametersLength,
    char ** programOutput,
    long *  programOutputLength,
    char ** messageDescriptor,
    char *  messageDescriptorLength,
    char *  errorIdBuffer,
    long *  errorIdBufferLength,
    char *  errorDescriptionBuffer,
    long *  errorDescriptionBufferLength)
```

Parameters:

void * exitHandle

- Reference to the invocation environment for this exit
- Input parameter

void * invocationContext

- Address of data describing the context in which the invocation of the request is to be done.
- For the context information provided by MQSeries Workflow for OS/390, see "Invocation context" on page 215
- input parameter

char * serviceName

- Name of service as known to MQSeries Workflow for OS/390 where the requested application is to be performed.
- Input parameter

long serviceNameLength

- Length of serviceName character string
- Input parameter

char * connectionParameters

- Character string providing the parameters needed by the invocation to connect to the service where the requested program should run. These parameters are defined for the respective service in the PES directory.
- Input parameter
- See also "Connection parameters" on page 216

long connectionParametersLength

- Length of connectionParameters
- Input parameter

char * executableName

- Address of buffer containing the name of the executable of the request
- For asynchronous invocations only: the program execution server passes zero to indicate that this function is called to handle a reply message from an asynchronously invoked program execution request.
- Input parameter

long executableNameLength

- Length of executableName
- Input parameter

char * executableType

- Type of the program specified by the executableName
- Input parameter

long executableTypeLength

- Length of executableType
- Input parameter

char * executionParameters

- Parameters for the program specified by the executable name
- Reply from an asynchronously performed execution request
- Input parameter

long executionParametersLength

- Length of executionParameters or the asynchronous reply
- Input parameter

char ** programOutput

- Pointer to the address of return buffer containing the output of the executable
- Asynchronous invocations also use this parameter to return the protocol-conforming message to the program execution server corresponding to the execution request passed in **executableName** and **executionParameters**.
- This buffer is created and owned by the exit and passed to the PES.
- Input/output parameter

long * programOutputLength

- Pointer to length of output data or the protocol-conforming message

- Input/output parameter

char ** messageDescriptor

- Pointer to the address of a buffer containing a message descriptor
- For asynchronous invocations only
- If the executable name is passed (request message has been constructed), the buffer is created and owned by the exit and passed to the PES. If a reply message is being handled, the buffer is created and owned by the PES and passed to the exit.
- Input/output parameter

long * messageDescriptorLength

- Pointer to length of the message descriptor
- For asynchronous invocations only
- Input/output parameter

char * errorIdBuffer

- See "Return codes and error messages" on page 202 for detailed information.

long * errorIdBufferLength

- See "Return codes and error messages" on page 202 for detailed information.

char * errorDescriptionBuffer

- See "Return codes and error messages" on page 202 for detailed information.

long * errorDescriptionBufferLength

- See "Return codes and error messages" on page 202 for detailed information.

Return codes:

FMC_EXIT_OK

- See "Return codes and error messages" on page 202 for detailed information.

FMC_EXIT_RECOVERABLE_ERROR

- See "Return codes and error messages" on page 202 for detailed information.

FMC_EXIT_NONRECOVERABLE_ERROR

- See "Return codes and error messages" on page 202 for detailed information.

Recogn()

Header files: FMCXIEP.H (invocation exit).

Function:

- Checks whether the reply message passed as message descriptor and message data is recognized by the invocation type this exit represents.
- This method applies to exits for asynchronous invocations. However, this entry point must also be provided by synchronous invocation exits. For these exits, FMC_INV_NOT_RECOGNIZED must always be returned.

- This function is called for all asynchronous invocation exits when an invocation reply message is received. It is assumed that there are no ambiguities, so that the first invocation exit where this function recognizes this message is the correct one to handle it.

Interface:

```
long Recogn
   (void * exitHandle
    char * messageDescriptor,
    long   messageDescriptorLength,
    char * messageData,
    long   messageDataLength)
```

Parameters:

void * exitHandle

- Reference to the invocation environment for this exit
- Input parameter

char * messageDescriptor

- Descriptor of the reply message
- Input parameter

long messageDescriptorLength

- Length of messageDescriptor
- Input parameter

char * messageData

- The data of the reply message
- Input parameter

long messageDataLength

- Length of messageData
- Input parameter

Return codes:

FMC_INV_NOT_RECOGNIZED
The message is not recognized

FMC_INV_RECOGNIZED
The message is recognized

IsAsync()

Header files: FMCXIEP.H (invocation exit).

Function:

- Returns whether the exit represents an asynchronous invocation.

Interface:

```
long IsAsync
   (void* exitHandle)
```

Parameters:

void * exitHandle

- Reference to the invocation environment for this exit

- Input parameter

Return codes:

FMC_INV_SYNCHRONOUS
The invocation is synchronous.

FMC_INV_ASYNCHRONOUS
The invocation is asynchronous.

Invocation context

The PES passes an invocation context to the invocation exit for **HdlRequ()**. It contains information about the context in which the request should be executed. There are four different context types: Workflow, Security, Transaction, and Performance. The context is created by the PES. The content depends on server and program settings. The workflow context is passed for internal reasons and is not intended to be used by an invocation exit. The security context is either set to the PES user ID or the execution user ID resolved for the request. The transaction context is set to a nonzero value if the request is to be executed as a safe application. The performance context is set to the WLM enclave token if the PES is running WLM-managed.

An invocation accesses the context by using a C-type interface defined in the included file fmcxiinv.h.

GetContext()

Header files: FMCXIINV.H (invocation context).

Function:

- Extracts the value of the context type as specified by a passed context name.

Interface:

```
int GetContext
   (void *  invContext,
    char *  invContextName,
    char ** invContextValue,
    long *  invContextValueLength)
```

Parameters:

void * invContext

- Address of the complete invocation context containing all context types
- Input parameter

char * invContextName

- Name of the requested context type
- Can be one of the character string constants as listed in the *Name* column in the *Context types* table below.
- Input parameter

char ** invContextValue

- Address to which this function puts the pointer to the value of the requested context type
- Input/output parameter

long * invContextValueLength

- Address to which this function puts the length of the value of the requested context type
- Input/output parameter

Return codes:

FMC_INV_CTX_ON
Context successfully retrieved

FMC_INV_CTX_NOT_SET
Context has not been set

FMC_INV_CTX_NOT_DEFINED
Context not found

Table 16. Context types

Type	Meaning	Used by	Name
Workflow	Contains the Workflow context	Internal use only	FMC_WORKFLOW_CTX
Security	Contains the user identification the request should be executed for	Invocation exit	FMC_SECURITY_CTX
Transaction	Contains an indication that the request should be executed in a transactional context	Invocation exit	FMC_TRANSACT_CTX
Performance	Contains the WLM enclave token, if the PES is running WLM managed	Invocation exit	FMC_PERFMGMT_CTX

To link your exit correctly, you must include definition side deck FMCH0XIC from *InstHLQ*.SFMCDSD.

Connection parameters

The parameter *connectionParameters* of the entry point **HdlRequ()** represents a character string of up to 254 printable characters. This string contains the parameters needed by the invocation to connect to the service system in order to execute an application there.

Connection parameters for synchronous invocations: For synchronous invocations, these parameters and the syntax how to specify them must be defined by the developer of an invocation exit. In most cases it is recommended to use the following syntax:

```
<keyword_1>=<value_1>;<keyword_2>=<value_2>;...;<keyword_n>=<value_n>
```

where the parameters are represented by key-value pairs separated by semicolons. Nevertheless, you can define the syntax of the connection parameters for your invocation exit. Connection parameters and the syntax how to specify them must be part of the documentation of your invocation exit, since an MQSeries Workflow for OS/390 administrator must specify this string when defining this exit to the PES directory.

Connection parameters for asynchronous invocation: Because only asynchronous invocations based on MQSeries queues are supported, the connection parameters for asynchronous invocations and the syntax how to specify them must be

```
[QUEUEMANAGER=<queuemanagername>;]INPUTQUEUE=<inputqueuename>
```

where <queuemanagername> and <inputqueuename> represent the MQSeries queue manager or MQSeries queue, respectively, and must follow the corresponding MQSeries naming rules. These parameters define the MQSeries queue to which the request message created by an asynchronous invocation exit must be put. QUEUEMANAGER is optional and should be omitted when the target queue manager is part of a queue manager cluster. When work distribution is required, INPUTQUEUE should specify a cluster queue defined with the attribute DEFBIND=<NOTFIXED>. At least two queues with this name should exist within the cluster.

Enabling MQSeries Workflow for OS/390 to use an invocation exit

In order to use a program invocation exit, the exit must reside in a DLL which must be available in a link library used by the PES.

> **Note:**
> If more than one asynchronous invocation exit recognizes the same kind of reply messages, it is unpredictable which of the exits will handle a reply message. This may lead to incorrect results, the cause of which may be difficult to determine.

See also "Program execution" in *MQSeries Workflow for OS/390: Customization and Administration*.

Invocation exit coding example

Since an invocation exit assumes there is a special kind of service system available where an application should run, there are no compiling sources provided as samples but rather a skeleton for synchronous invocations FMCHSIVS and one for asynchronous invocations FMCHSIVA, both in *InstHLQ*.SFMCSRC and written in C.

Notification exit

The PES supports an exit that provides notification whenever one of the following events happens in the PES:

- The PES is about to invoke a program
- The PES has successfully invoked a program
- A failure occurs when the PES tries to invoke a program.

The exit can be used for various purposes, such as to write journal records. It can perform its operation in either transaction or non-transaction mode. If in transaction mode, the exit must participate in the global transactions that are controlled by the PES. In particular, this means that the exit must not issue commit or rollback requests and that it must use resource managers that are coordinated by OS390/RRS (see “Use of RRS commit and rollback” on page 205).
Non-transaction mode implies that the exit does not record its persistent data via resource managers but rather directly in data sets, for example.

It is strongly recommended that the exit work in transaction mode, since it is otherwise not possible to synchronize PES actions with those of the exit.

The notification exit must be available in a DLL that is loaded by the PES and used to call the exit. This DLL must have the name FMCXNEXT. IBM does not supply

an executable for this exit, and it must therefore be provided by the customer. To activate the notification exit, the variable **PesNotificationExit** must be set to 1 in the configuration profile. If this variable is set, the PES tries to load and initialize the notification exit at PES startup time. If the variable is set and the exit cannot be loaded or initialized correctly, the PES will not start properly.

The notification exit must have the two exit functions **Init()** and **Deinit()** common to all PES exits (see "Interfaces for all exits" on page 203).

When the **Init()** function is called, the `initializationParameters` buffer has two key=value pairs in the following format:

```
ASID=<asid>;TCBID=<tcbid>
```

where `<asid>` and `<tcbid>` are the address space and task control block IDs, respectively, of the corresponding PES instance.

Additional interfaces specific to the notification exit

The entry points specific to the notification exit are:

- Notification of a 'before invocation' event (**EVB4INV()**)
- Notification of a 'successful invocation' event (**EVIVSUCC()**)
- Notification of an 'invocation failure' event (**EVIVFAIL()**)

When the PES receives a request to start a program, it performs the following steps:

1. Phase Ia processing
   - Validate message parameters
   - Look up connection parameters in directory
   - Retrieve local user ID and check user authorization if required
2. Phase Ib processing
   - Retrieve invocation exit information
   - Load and initialize invocation exit if not already done
   - Retrieve mapping exit information
   - Load and initialize mapping exit if not already done
   - Map forward if desired
3. Phase II processing
   - Invoke the program
   - Map backward if desired
   - Send reply message to originator of the request

The notification exit function **EVB4INV()** is called immediately after Phase Ia processing is complete. If an error occurs during Phase Ia, an error message is returned to the originator of the request, but the notification exit is not called.

If an error occurs during Phases Ib or II, the notification exit function **EVIVFAIL()** is called, and an error message is returned to the originator of the request.

The PES passes to the notification exit functions all data required to identify the workflow request that is currently being processed. In particular, this means that the program's containers are passed to the exit. The exit functions can use the Container API to access the contents of the containers.

In order to enable correlation between **EVB4INV()** and **EVIVSUCC()/EVIVFAIL()** calls, the PES passes the MQ MessageID of the received InvokeProgram request message to all notification entry points. This ID can be used as a correlation ID that is unique for each program invocation request processed by the PES (called program invocation instance).

The exit behavior differs depending on whether the program invocation is synchronous or asynchronous:

Synchronous invocation: When the PES cannot invoke a program correctly (i.e., as soon as it detects an error after calling **EVB4INV()**, which can be a mapping, invocation, or directory error), it calls **EVIVFAIL()**. It passes **EVIVFAIL()** the same MQ Message ID buffer that was passed to **EVB4INV()** as well as the available error information.

If the invocation is successful, the PES calls **EVIVSUCC()** as soon as the output containers of the program are available, i.e., after calling the mapping exit for BACKWARD_MAPPING if MAPPING is specified in the definition of the external program, or after the invocation exit returns and the PES has constructed the output container if NO MAPPING is specified in the definition of the external program.

The PES passes **EVIVSUCC()** the same MQ Message ID buffer that was passed to **EVB4INV()**, as well as the program's output container.

Asynchronous invocation: If the invocation is asynchronous, the processing of the program's reply data takes place in a second transaction. If program invocation is successful, the PES calls **EVIVSUCC()** in this second transaction after **HdlRequ()** returns from handling the program's reply and the output containers are available (either by direct action in the PES or by calling the mapping exit for BACKWARD_MAPPING).

If an error occurs in the process (e.g. **Recogn()**, **HdlRequ()**, or the mapping exit returns an error), the PES will call **EVIVFAIL()** as soon as it detects the error condition.

Regardless of the invocation type, there are two calls to the notification exit for each program invocation: **EVB4INV()** and **EVIVSUCC()** if the invocation is successful, or **EVB4INV()** and **EVIVFAIL()** otherwise.

EVB4INV()

Header file: FMCXNEIF.H (notification exit).

Function:

- This exit function is called when the PES is about to invoke a program. It is called by the PES before it prepares the program's input buffer. If forward mapping is desired, **EVB4INV()** is called before the mapping exit for forward mapping is called.

Interface:

```
long EVB4INV
    (void * exitHandle,
     void * inputContainerHandle,
     void * invocationContext,
     char * userName,
     long   userNameLength,
```

```
void * workFlowCorrelId,
long   workFlowCorrelIdLength,
char * serviceName,
long   serviceNameLength,
char * connectionParameters,
long   connectionParametersLength,
char * executableName,
long   executableNameLength,
char * executableType,
long   executableTypeLength,
void * rqMQMessageID,
long   rqMQMessageIDLength,
char * errorIdBuffer,
long * errorIdBufferLength,
char * errorDescriptionBuffer,
long * errorDescriptionBufferLength)
```

Parameters:

void * exitHandle

- Pointer passed to the **Init()** function, which is not used by the PES but passed to any function called subsequently. Used to pass exit environment data between the PES and all exit functions.
- Input/output parameter

void * inputContainerHandle

- Handle of the MQSeries Workflow for OS/390 input container. Argument in MQSeries Workflow for OS/390 Container API calls to access the container.
- Input parameter

void * invocationContext

- Address of the data describing the context in which the invocation of the request is to be done.
- For the context information provided by MQSeries Workflow for OS/390, see "Invocation context" on page 215.
- Input parameter

char * userName

- String containing the name of the user on whose behalf the program is started.
- Input parameter

long userNameLength

- Length of the userName string.
- Input parameter

void * workFlowCorrelId

- Binary buffer containing the workflow correlation ID. This field can be used to correlate the current program invocation instance with the state of the workflow's process instance. The field contains either an ActImplCorrelID structure or an FmcCorrelationID structure, depending on the originator of the start program request:
  - an FmcActImplCorrelID structure if the program start request comes from MQ Workflow's execution server
  - an FmcCorrelationID structure if the program start request comes from a client application that issued an ExecuteProgram API call (**FmcjProgramTemplateExecute()** function).

The field can also be empty, i.e., the parameter can have the value NULL or the length can be 0.

- Input parameter

long workFlowCorrelIdLength

- Length of the workFlowCorrelId buffer. If 0, the buffer is considered empty.
- Input parameter

char * serviceName

- Name of the service, as known to MQSeries Workflow for OS/390, on which the application is to be performed.
- Input parameter

long serviceNameLength

- Length of the serviceName character string.
- Input parameter

char * connectionParameters

- Character string providing the parameters needed by the invocation to connect to the service under which the requested program is to run. These parameters are defined for the respective service in the PES directory.
- Input parameter
- See also "Connection parameters" on page 216.

long connectionParametersLength

- Length of connectionParameters
- Input parameter

char * executableName

- Address of buffer containing the name of the executable of the request
- Input parameter

long executableNameLength

- Length of executableName
- Input parameter

char * executableType

- Type of the program specified by the executableName
- Input parameter

long executableTypeLength

- Length of executableType
- Input parameter

void * rqMQMessageID

- Buffer that contains the MQ Message ID of the InvokeProgram request. This ID uniquely identifies the current program invocation instance. The same ID will be passed to **EVIVSUCC()/EVIVFAIL()** in order to enable correlation.
- Input parameter

long rqMQMessageIDLength

- Length of the rqMQMessageID buffer

- Input parameter

char * errorIdBuffer

- See "Return codes and error messages" on page 202 for detailed information.

long * errorIdBufferLength

- See "Return codes and error messages" on page 202 for detailed information.

char * errorDescriptionBuffer

- See "Return codes and error messages" on page 202 for detailed information.

long * errorDescriptionBufferLength

- See "Return codes and error messages" on page 202 for detailed information.

EVIVSUCC()

Header files: FMCXNEIF.H (notification exit).

Function:

- Notifies the exit that a program invocation has been successfully completed.

Invocations: **EVIVSUCC()** is invoked:

- For synchronous invocations: after the invocation exit function **HdlRequ()** returns to the PES with a return code of 0 and the output container is available (either by calling the mapping exit or by internal actions).
- For asynchronous invocations: when the PES has received the program's reply data from the MQ bridge, successfully called **Recogn()** and the **HdlRequ()** function of the appropriate invocation exit, and constructed the output container (either by calling the mapping exit or by internal actions).

Interface:

```
long EVIVSUCC
    (void * exitHandle,
     void * outputContainerHandle,
     void * rqMQMessageID,
     long   rqMQMessageIDLength,
     char * errorIdBuffer,
     long * errorIdBufferLength,
     char * errorDescriptionBuffer,
     long * errorDescriptionBufferLength)
```

Parameters:

void * exitHandle

- Pointer passed to the **Init()** function, which is not used by the PES but passed to any function called subsequently. Used to pass exit environment data between the PES and all exit functions.
- Input/output parameter

void * outputContainerHandle

- Handle of the MQSeries Workflow for OS/390 output container. Argument in MQSeries Workflow for OS/390 Container API calls to access the container.

- Input parameter

void * rqMQMessageID

- Buffer that contains the MQ Message ID of the InvokeProgram request. This ID uniquely identifies the current program invocation instance. The same ID was passed to **EVB4INV()**.
- Input parameter

long rqMQMessageIDLength

- Length of the rqMQMessageID buffer
- Input parameter

char * errorIdBuffer

- See "Return codes and error messages" on page 202 for detailed information.

long * errorIdBufferLength

- See "Return codes and error messages" on page 202 for detailed information.

char * errorDescriptionBuffer

- See "Return codes and error messages" on page 202 for detailed information.

long * errorDescriptionBufferLength

- See "Return codes and error messages" on page 202 for detailed information.

EVIVFAIL()

Header files: FMCXNEIF.H (notification exit).

Function:

- Notifies the exit that an attempt to invoke a program has failed.

Invocations: The PES will call **EVIVFAIL()** as soon as it detects an error after calling **EVB4INV()**.

- For synchronous invocations, this can be one of the following situations:
  - **EVB4INV()** returns an error to the PES.
  - The PES cannot retrieve the information for the invocation exit from the directory.
  - The invocation exit cannot be loaded and initialized correctly.
  - The PES cannot retrieve the information for the mapping exit from the directory.
  - The mapping exit cannot be loaded and initialized correctly.
  - The PES is unable to prepare the program's input buffer.
  - The mapping exit for FORWARD_MAPPING returns an error.
  - The **HdlRequ()** call of the invocation exit returns an error.
  - The mapping exit for BACKWARD_MAPPING returns an error.
  - The PES is not able to construct the output container of the program.
- For asynchronous invocations, this can be one of the following situations:
  - **EVB4INV()** returns an error to the PES.
  - The PES cannot retrieve the information for the invocation exit from the directory.

- The invocation exit cannot be loaded and initialized correctly.
- The PES cannot retrieve the information for the mapping exit from the directory.
- The mapping exit cannot be loaded and initialized correctly.
- The PES is unable to prepare the program's input buffer.
- The mapping exit for FORWARD_MAPPING returns an error.
- The **HdlRequ()** call of the PES transaction that processes the program invocation returns an error.
- The program is invoked, but an error occurs in the transaction that processes the program's reply data. Possible errors are:
  - **Recogn()** returns an error.
  - **HdlRequ()** returns an error.
  - The mapping exit for BACKWARD_MAPPING returns an error.
  - The PES is not able to construct the output container of the program.

Interface:

```
long EVIVFAIL
    (void * exitHandle,
     void * rqMQMessageID,
     long   rqMQMessageIDLength,
     char * processingErrorId,
     long   processingErrorIdLength,
     char * processingErrorDescription,
     long   processingErrorDescriptionLength,
     char * errorIdBuffer,
     long * errorIdBufferLength,
     char * errorDescriptionBuffer,
     long * errorDescriptionBufferLength)
```

Parameters:

void * exitHandle

- Pointer passed to the **Init()** function, which is not used by the PES but passed to any function called subsequently. Used to pass exit environment data between the PES and all exit functions.
- Input/output parameter

void * rqMQMessageID

- Buffer that contains the MQ Message ID of the InvokeProgram request. This ID uniquely identifies the current program invocation instance. The same ID was passed to **EVB4INV()**.
- Input parameter

long rqMQMessageIDLength

- Length of thg rqMQMessageID buffer
- Input parameter

char * processingErrorId

- Character buffer that contains the ID of the error that occurred in the processing of the current program invocation instance since the call to **EVB4INV()**. This error ID may have been set by the directory, invocation, or mapping exit, or by the PES.
- Input parameter

long processingErrorIdLength

- Length of the processingErrorId buffer.

- Input parameter

char * processingErrorDescription

- Character buffer that contains the description of the error that occurred in the processing of the current program invocation instance since the call to **EVB4INV()**. This error description may have been set by the directory, invocation, or mapping exit, or by the PES.
- Input parameter

long processingErrorDescriptionLength

- Length of the processingErrorDescription buffer.
- Input parameter

char * errorIdBuffer

- See "Return codes and error messages" on page 202 for detailed information.

long * errorIdBufferLength

- See "Return codes and error messages" on page 202 for detailed information.

char * errorDescriptionBuffer

- See "Return codes and error messages" on page 202 for detailed information.

long * errorDescriptionBufferLength

- See "Return codes and error messages" on page 202 for detailed information.

Return codes: See "Return codes and error messages" on page 202 for the return codes. If **EVIVFAIL()** returns FMC_EXIT_OK, the PES sends the original error back to the originator of the request, i.e., in processingErrorID/processingErrorDescription. If **EVIVFAIL()** returns FMC_EXIT_RECOVERABLE_ERROR or FMC_EXIT_NONRECOVERABLE_ERROR, the PES sends the error from **EVIVFAIL()** back to the originator of the request, i.e., the error that is returned in errorIDBuffer and errorDescriptionBuffer.

Chapter 4. API classes and objects

This chapter lists the individual classes and objects in the API and their component API calls.

Summary

An alphabetical list of API classes and objects follows. Unless otherwise stated, indicated names are valid Java classes. To become valid C++ classes, a prefix of ″Fmcj″ must be added. To become valid C or COBOL calls, the class name must be prefixed with ″Fmcj″ and extended by the actual function name. For example, if the C++ class is ″FmcjWorkitem″, all functions in C or COBOL start with ″FmcjWorkitem″; ″FmcjWorkitemStart″, for example, is a valid C function and COBOL subprogram name.

Note: In the following discussions, use of the listed class names should be understood as a generic designation that also applies to C, C++, and COBOL.

To adhere to language requirements, the paragraph names in copybook fmcperf.cpy are usually abbreviated versions of the C function names. For more information concerning COBOL naming conventions, see “COBOL interface” on page 135.

Class/Object	Description
ActivityInstance	An instance of a workflow process template activity.
ActivityInstanceNotification	A notification associated with an activity instance.
ActivityInstanceNotificationVector	The C or COBOL result of a query for activity instance notifications.
ActivityInstanceVector	The C or COBOL result of a query for activity instances.
Agent	An agent in the Java API to access an MQSeries Workflow domain.
BlockInstanceMonitor	The monitor for an activity instance of kind Block.
Calendar	The date/time object for Java. See ″Date and Time″.
Container	The data container of a work item or a process instance.
ContainerElement	An element of a data container.
ContainerElementVector	The C or COBOL result of a query for container elements.
ControlConnectorInstance	The instance of a control connector between two activity instances.
ControlConnectorInstanceVector	The C or COBOL result of a query for control connector instances.

API classes and objects

Class/Object	Description
Date and Time	The corresponding C++ object is FmcjDateTime. FmcjCDateTime is the equivalent structure in C and COBOL. **Note:** Java uses the Calendar object.
DllOptions	The program implementation definitions for a dynamic link library.
ExecutionData	Information pushed by an MQSeries Workflow execution server or the response to an asynchronous request.
ExecutionAgent	The Java representation of an MQSeries Workflow program execution agent.
ExecutionService	The representation of a session between a user and an MQSeries Workflow execution server so that services can be requested.
ExeOptions	The program implementation definitions for an executable.
ExternalOptions	The program implementation definitions for an external service.
FmcError	Describes the cause of a state InError in Java. The C++ class is called FmcjError.
FmcException	The Java representation of an exception.
Global	A means to group API calls which are global API calls in C, C++, and COBOL.
ImplementationData	The program implementation definitions.
Item	An item associated with a user; can be a work item or notification.
ItemVector	The C or COBOL result of a query for items.
Message	A means to request a formatted message (in the local language, if applicable) for a known message ID; only C, COBOL, and C++.
PersistentList	A list definition stored persistently.
Person	User-specific settings for the user logged on to an MQSeries Workflow execution server.
Point	Describes the bend points of a control connector instance.
PointVector	The C or COBOL result of a query for bend points.
ProcessInstance	An instance of a workflow process template.
ProcessInstanceList	A list to group process instances.
ProcessInstanceListVector	The C or COBOL result of a query for process instance lists.
ProcessInstanceMonitor	The monitor for a process instance.
ProcessInstanceNotification	A notification associated with a process instance.
ProcessInstanceNotificationVector	The C or COBOL result of a query for process instance notifications.
ProcessInstanceVector	The C or COBOL result of a query for process instances.

Class/Object	Description
ProcessTemplate	A workflow process template consisting of activities and containers and their control and data flow.
ProcessTemplateList	A list to group process templates.
ProcessTemplateListVector	The C or COBOL result of a query for process template lists.
ProcessTemplateVector	The C or COBOL result of a query for process templates.
ProgramData	The program definitions of an activity implementation.
ProgramTemplate	A program definition contained in a process template.
ReadOnlyContainer	A data container that can only be read.
ReadWriteContainer	A data container that can be read and written to.
Result	The detailed result of a request; only C, COBOL, and C++.
Service	Provides for common aspects of MQSeries Workflow services.
StringVector	The C or COBOL result of a query resulting in a list of strings or the C or COBOL means of providing a list of strings.
SymbolLayout	Describes the graphical layout of an activity instance.
Workitem	A user-assigned activity instance to be worked on.
WorkitemVector	The C or COBOL result of a query for work items.
Worklist	A list to group work items or notifications.
WorklistVector	The C or COBOL result of a query for worklists.

API calls by class

Note: In the following descriptions, the basic methods listed are not differentiated by language. Not all of these methods are available in each language.

ActivityInstance

An activity instance represents an instance of a process template activity. It is part of a process instance.

Refer to “Basic API calls” on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs an activity instance object.	71
Copy()	Allocates and initializes the storage for an activity instance object by copying.	74
Deallocate()	Deallocates the storage for an activity instance object.	75
destructor()	Destructs an activity instance object.	75
Equal()	Compares two activity instances.	73

Basic methods	Description	Page
IsComplete()	Indicates whether the complete activity instance information is available.	75
IsEmpty()	Indicates whether activity instance information is not available.	76
Kind()	States the kind of the activity instance, whether it is a program, a process, or a block.	76
operator=()	Assigns an activity instance to this one.	73
operator==()	Compares two activity instances.	73

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls.

Note: The value in the **Set** column shows if this attribute is a primary attribute (P) and set immediately when activity instances are queried or if this attribute is a secondary attribute (S) and set only after the refresh of a specific activity instance. Note that the activity instances returned by the (process or block) instance monitor contain both primary and secondary values.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Set/ Type	Description	Page
ActivationTime()	P/D	Returns the activation time of the activity instance.	88
ActivationTimeIsNull()	P/B	Indicates whether an activation time is set.	111
Category()	P/C	Returns the process category of the activity instance.	108
CategoryIsNull()	P/B	Indicates whether a category is set.	111
Description()	P/C	Returns the description of the activity instance.	108
DescriptionIsNull()	P/B	Indicates whether a description is set.	111
Documentation()	S/C	Returns the documentation of the activity instance.	108
DocumentationIsNull()	S/B	Indicates whether a documentation is set.	111
EndTime()	S/D	Returns the ending time of the activity instance.	88
EndTimeIsNull()	S/B	Indicates whether an end time is set.	111
ErrorReason()	S/O	Returns an error object describing the reason why the activity instance is in the state InError.	109

Accessor methods	Set/ Type	Description	Page
ErrorReasonIsNull()	S/B	Indicates whether an error reason is set.	111
ExitCondition()	S/C	Returns the exit condition of the activity instance.	108
FirstNotificationTime()	S/D	Returns the time the first notification for the activity instance is to occur or has occurred.	88
FirstNotificationTimeIsNull()	S/B	Indicates whether a first notification time is set.	111
FirstNotifiedPersons()	S/M	Returns the persons who received a first notification for the activity instance.	109
FullName()	P/C	Returns the fully qualified name of the activity instance (dot notation).	108
Icon()	P/C	Returns the icon associated with the activity instance.	108
Implementation()	P/C	Returns the name of the implementing program of the activity instance.	108
ImplementationIsNull()	P/B	Indicates whether an implementation is set.	111
InContainerName()	S/C	Returns the name of the input container of the activity instance.	108
LastModificationTime()	P/D	Returns the last time a primary attribute of the activity instance was changed.	88
LastStateChangeTime()	P/D	Returns the last time the state of the activity instance changed.	88
ManualExitMode()	S/B	Returns whether the exit mode of the activity instance is manual.	87
ManualStartMode()	S/B	Returns whether the start mode of the activity instance is manual.	87
Name()	P/C	Returns the name of the activity instance.	108
OutContainerName()	S/C	Returns the name of the output container of the activity instance.	108
PersistentOid()	P/C	Returns a representation of the object identification of the activity instance.	108
Priority()	P/I	Returns the priority of the activity instance.	107
PriorityIsNull()	P/B	Indicates whether a priority is set.	111
ProcessAdmin()	S/C	Returns the process administrator of the activity instance.	108
ProcessAdminIsNull()	S/B	Indicates whether a process administrator is set.	111

Accessor methods	Set/ Type	Description	Page
ProcessInstanceName()	P/C	Returns the name of the process instance the activity instance is part of.	108
ProcessInstanceState()	P/E	Returns the state of the process instance the activity instance is part of.	88
ProcessInstanceSystemGroupName()	S/C	Returns the name of the system group of the process instance the item is part of.	108
ProcessInstanceSystemName()	S/C	Returns the name of the system of the process instance the activity instance is part of.	108
SecondNotificationTime()	S/D	Returns the time the second notification for the activity instance is to occur or has occurred.	88
SecondNotificationTimeIsNull()	S/B	Indicates whether a second notification time is set.	111
SecondNotifiedPersons()	S/M	Returns the persons who received a second notification for the activity instance.	109
Staff()	S/M	Returns all persons a work item for the activity instance has been assigned to.	109
StartCondition()	S/C	Returns the start condition of the activity instance.	108
Starter()	P/C	Returns the starter of the activity instance.	108
StarterIsNull()	P/B	Indicates whether a starter is set.	111
StartTime()	P/D	Returns the start time of the activity instance.	88
StartTimeIsNull()	P/B	Indicates whether a start time is set.	111
State	P/E	Returns the state of the activity instance.	88
StateOfNotification()	S/E	Returns the notification state of the activity instance.	88
SupportTools()	P/M	Returns the support tools associated with the activity instance.	109
SupportToolsIsNull()	P/B	Indicates whether support tools are set.	111
SymbolLayout()	S/O	Returns the symbol layout of the activity instance.	109

Refer to “Action API calls” on page 122 for detailed descriptions of action API calls.

Action methods	Description	Page
ObtainProcessInstanceMonitor()	Retrieves the process instance monitor for the process instance the activity instance is part of.	287
SubProcessInstance()	Retrieves the process instance implementing the activity instance of type Process.	289

ActivityInstanceNotification

An activity instance notification represents a notification for an activity instance.

Note: All API calls of FmcjItem are also applicable to activity instance notifications.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs an activity instance notification object.	71
Copy()	Allocates and initializes the storage for an activity instance notification object by copying.	74
Deallocate()	Deallocates the storage for an activity instance notification object.	75
destructor()	Destructs an activity instance notification object.	75
Kind()	In C++, states that the object is an activity instance notification.	76
operator=()	Assigns an activity instance notification to this one.	73
operator==()	Compares two activity instance notifications.	73

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls.

Note: The value in the **Set** column shows if this attribute is a primary attribute (P) and set immediately when activity instance notifications are queried or if this attribute is a secondary attribute (S) and set only after the refresh of a specific activity instance notification.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Set/ Type	Description	Page
ActivityKind()	P/E	Returns the kind of the associated activity instance, whether it is a program or process and so on.	88
ErrorReason()	S/O	Returns an error object describing the reason why the associated activity instance is in state InError.	109
ErrorReasonIsNull()	S/B	Indicates whether an error reason is set.	111

API classes and objects

Accessor methods	Set/ Type	Description	Page
ExitCondition()	S/C	Returns the exit condition of the associated activity instance.	108
Expired()	P/B	Returns whether the associated activity instance has been started and is expired now.	87
FirstNotificationTime()	S/D	Returns the first notification time of the activity instance, that is, the time when this notification has been created.	88
Implementation()	P/C	Returns the implementing program or process name of the associated activity instance.	108
ImplementationIsNull()	P/B	Indicates whether an implementation is set.	111
ManualExitMode()	S/B	Returns whether the exit mode of the associated activity instance is manual.	87
ManualStartMode()	S/B	Returns whether the start mode of the associated activity instance is manual.	87
Priority()	P/I	Returns the priority of the associated activity instance.	107
SecondNotificationTime()	S/D	Returns the second notification time of the associated activity instance.	88
SecondNotificationTimeIsNull()	S/B	Indicates whether a second notification time is set.	111
Staff()	S/M	Returns all persons owning a work item for the associated activity instance.	109
StartCondition()	S/C	Returns the start condition of the associated activity instance.	108
StartOverdue()	P/B	Returns whether the start of the associated activity instance is overdue.	87
State	P/E	Returns the state of the associated activity instance.	88
StateOfNotification()	S/E	Returns the notification state of the associated activity instance.	88
SupportTools()	P/M	Returns the support tools associated with the activity instance.	109
SupportToolsIsNull()	P/B	Indicates whether support tools are set.	111

Refer to “Action API calls” on page 122 for detailed descriptions of action API calls.

Action methods	Description	Page
PersistentObject()	Retrieves the specified activity instance notification.	292
StartTool()	Starts the specified support tool.	294

ActivityInstanceNotificationVector

An activity instance notification vector represents the result of a query for activity instance notifications in C or COBOL.

Refer to "C and COBOL vector accessor functions" on page 21 for detailed descriptions of vector functions.

Vector methods	Description
Deallocate()	Deallocates an activity instance notification vector object.
FirstElement()	Returns the first element of the activity instance notification vector.
NextElement()	Returns the next element of the activity instance notification vector.
Size()	Returns the number of elements in the activity instance notification vector.

ActivityInstanceVector

An activity instance vector represents the result of a query for activity instances in C or COBOL.

Refer to "C and COBOL vector accessor functions" on page 21 for detailed descriptions of vector access functions.

Accessor methods	Description
Deallocate()	Deallocates an activity instance vector object.
FirstElement()	Returns the first element of the activity instance vector.
NextElement()	Returns the next element of the activity instance vector.
Size()	Returns the number of elements in the activity instance vector.

Agent

An agent object represents an MQSeries Workflow instance in Java.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs an agent object. Initially an agent has no context, locator policy, or name.	71

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. All properties are primary properties.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
addPropertyChangeListener()	O	Adds the specified listener to the set of listeners to be notified of property changes.	113
addVetoableChangeListener()	O	Adds the specified listener to the set of listeners to be notified of vetoable property changes.	113
getConfigurationID()	C	Returns the configuration to be used for profile accesses.	108
getExecutionAgent()	O	Returns a program execution agent to the calling activity implementation provided that the LOC_LOCATOR policy was used. Otherwise, null is returned.	109
getLocator()	I	Returns the locator policy; can be COS_LOCATOR, IOR_LOCATOR, LOC_LOCATOR, OSA_LOCATOR, RMI_LOCATOR.	107
getName()	C	Returns the name of the Java Agent. If the agent is not bound, an empty string is returned.	108
isBound()	B	Indicates whether the agent bean is bound to a Java CORBA agent.	87
locate()	O	Locates the execution service in the provided system group and system.	109
removePropertyChangeListener()	O	Removes the specified listener from the set of listeners.	113
removeVetoableChangeListener()	O	Removes the specified listener from the set of listeners.	113
setConfigurationID()	C	Sets the configuration ID to be used for profile access. A locator policy of LOC_LOCATOR is automatically assumed.	108
setContext()	O	Sets the context of the agent. An applet must set the context by issuing a *agent.setContext(this,null);*	109

Accessor methods	Type	Description	Page
setLocator()	I	Sets the locator policy; can be COS_LOCATOR, IOR_LOCATOR, LOC_LOCATOR, OSA_LOCATOR, RMI_LOCATOR. This call must precede the Agent.setName(). If LOC_LOCATOR is set, the default configuration ID for profile access is automatically used. **Note:** Java RMI agents should only be used for prototyping. They are currently not suited for production purposes.	112
setName()	C	Sets the name of the Java Agent.	108
toString()	C	Returns the name of the agent.	108

BlockInstanceMonitor

A block instance monitor object represents a monitor of an activity instance of type *Block*.

Note: All API calls of a block instance monitor are also applicable to process instance monitors.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
destructor()	Destructs a block instance monitor object, that is, the transient representation in the C++ interface. The internal block instance monitor object is, however, not deallocated since it is part of the process instance monitor. It is deallocated when the process instance monitor is destructed/deallocated.	75

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. All properties are primary because a block instance monitor is a part of a process instance monitor.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
ActivityInstances()	M	Returns the activity instances which are represented by the block instance monitor, that is, which are part of the activity instance of type *Block*. The activity instances contain both primary and secondary values.	109

Accessor methods	Type	Description	Page
ControlConnectorInstances()	M	Returns the control connector instances which are represented by the block instance monitor, that is, which are part of the activity instance of type *Block*.	109

Refer to "Action API calls" on page 122 for detailed descriptions of action API calls.

Action methods	Description	Page
ObtainBlockInstanceMonitor()	Returns the block instance monitor for an activity instance of type *Block*. The activity instance is part of the set of activity instances represented by the block instance monitor.	296
ObtainProcessInstanceMonitor()	Returns the process instance monitor for an activity instance of type *Process*. The activity instance is part of the set of activity instances represented by the block instance monitor.	298
Refresh()	Refreshes the block instance monitor from the MQSeries Workflow execution server.	301

Container

A container represents an input or output data container of a process instance or work item.

Note: All API calls of a container are applicable to read-only and read/write containers.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
IsEmpty()	Indicates whether container information is not available.	76

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. All properties are primary properties.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
AllLeafCount()	I	Returns the number of leaf elements of the container including the MQSeries Workflow predefined members.	37
AllLeaves()	M	Returns all leaf elements of the container including the MQSeries Workflow predefined members.	37

Accessor methods	Type	Description	Page
ArrayBinaryLength()	I	Returns the length of the value of the specified container leaf element in C or COBOL. The leaf is part of an array and of type BINARY.	47
ArrayBinaryValue()	C	Returns the value of the specified container leaf element in C or COBOL. The leaf is part of an array and of type BINARY.	47
ArrayFloatValue()	F	Returns the value of the specified container leaf element in C or COBOL. The leaf is part of an array and of type FLOAT.	47
ArrayLongValue()	I	Returns the value of the specified container leaf element in C or COBOL. The leaf is part of an array and of type LONG.	47
ArrayStringLength()	I	Returns the length of the value of the specified container leaf element in C or COBOL. The leaf is part of an array and of type STRING.	47
ArrayStringValue()	C	Returns the value of the specified container leaf element in C or COBOL. The leaf is part of an array and of type STRING.	47
BinaryLength()	I	Returns the length of the value of the specified container leaf element. The leaf is of type BINARY.	47
BinaryValue()	C	Returns the value of the specified container leaf element in C or COBOL. The leaf is of type BINARY.	47
FloatValue()	F	Returns the value of the specified container leaf element in C or COBOL. The leaf is of type FLOAT.	47
getBuffer()	C	Returns the value of the specified container leaf element in Java. The leaf is of type BINARY.	47
getBuffer2()	C	Returns the value of the specified container leaf element in Java. The leaf is part of an array and of type BINARY.	47
getDouble()	F	Returns the value of the specified container leaf element in Java. The leaf is of type FLOAT.	47
getDouble2()	F	Returns the value of the specified container leaf element in Java. The leaf is part of an array and of type FLOAT.	47
GetElement()	O	Provides access to a container element.	47
getLong()	I	Returns the value of the specified container leaf element in Java. The leaf is of type LONG.	47
getLong2()	C	Returns the value of the specified container leaf element in Java. The leaf is part of an array and of type LONG.	47
getString()	C	Returns the value of the specified container leaf element in Java. The leaf is of type STRING.	47

Accessor methods	Type	Description	Page
getString2()	C	Returns the value of the specified container leaf element in Java. The leaf is part of an array and of type STRING.	47
LeafCount()	I	Returns the number of user-defined leaf elements of the container.	47
Leaves()	M	Returns all user-defined leaf elements of the container.	47
LongValue()	I	Returns the value of the specified container leaf element in C or COBOL. The leaf is of type LONG.	47
MemberCount()	I	Returns the number of structural members in the container.	47
StringLength()	I	Returns the length of the value of the specified container leaf element in C or COBOL. The leaf is of type STRING.	47
StringValue()	C	Returns the value of the specified container leaf element in C or COBOL. The leaf is of type STRING.	47
StructMembers()	M	Returns the structural members of the container.	37
Type()	C	Returns the type of the container, that is, the data structure name.	37
Value()	C/I/F/N	Returns the value of the specified container leaf element in C++.	47

Refer to “Activity implementation API calls” on page 122 for detailed descriptions of activity implementation API calls.

Activity implementation methods	Description	Page
InContainer()	Accesses the input container from within an activity implementation; for Java, see ExecutionAgent.	303
OutContainer()	Accesses the output container from within an activity implementation; for Java, see ExecutionAgent.	305
RemoteInContainer()	Accesses the input container from within a program started by an activity implementation; for Java, see ExecutionAgent.	307
RemoteOutContainer()	Accesses the output container from within a program started by an activity implementation; for Java, see ExecutionAgent.	308
SetOutContainer()	Sets the output container from within an activity implementation; for Java, see ExecutionAgent.	310
SetRemoteOutContainer()	Sets the output container from within a program started by an activity implementation; for Java, see ExecutionAgent.	312

ContainerElement

A container element represents an arbitrary element of a container.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs a container element object.	71
Copy()	Allocates and initializes the storage for a container element object by copying.	74
Deallocate()	Deallocates the storage for a container element object.	75
destructor()	Destructs a container element object.	75
Equal()	Compares two container elements.	73
operator=()	Assigns a container element to another one.	73
operator==()	Compares two container elements.	73
IsEmpty()	Indicates whether container element information is not available.	76

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. All properties are primary properties because a container element describes a part of a container.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
ArrayBinaryLength()	I	Returns the length of the value of the specified container element leaf element in C or COBOL. The leaf is part of an array and of type BINARY.	54
ArrayBinaryValue()	C	Returns the value of the specified container element leaf element in C or COBOL. The leaf is part of an array and of type BINARY.	54
ArrayElements()	M	Returns the array elements of the container element.	41
ArrayFloatValue()	F	Returns the value of the specified container element leaf element in C or COBOL. The leaf is part of an array and of type FLOAT.	54
ArrayLongValue()	I	Returns the value of the specified container element leaf element in C or COBOL. The leaf is part of an array and of type LONG.	54
ArrayStringLength()	I	Returns the length of the value of the specified container element leaf element in C or COBOL. The leaf is part of an array and of type STRING.	54
ArrayStringValue()	C	Returns the value of the specified container element leaf element in C or COBOL. The leaf is part of an array and of type STRING.	54

Accessor methods	Type	Description	Page
BinaryLength()	I	Returns the length of the value of the specified container element leaf element. The leaf is of type BINARY.	54
BinaryValue()	C	Returns the value of the specified container element leaf element in C or COBOL. The leaf is of type BINARY.	54
Cardinality()	I	Returns the number of array elements of the container element.	41
FloatValue()	?	Returns the value of the specified container element leaf element in C or COBOL. The leaf is of type FLOAT.	54
FullName()	C	Returns the fully-qualified dotted name of the container element.	41
getBuffer()	C	Returns the value of the specified container element leaf element in Java. The leaf is of type BINARY.	47
getBuffer2()	C	Returns the value of the specified container element leaf element in Java. The leaf is part of an array and of type BINARY.	47
getDouble()	F	Returns the value of the specified container element leaf element in Java. The leaf is of type FLOAT.	47
getDouble2()	F	Returns the value of the specified container element leaf element in Java. The leaf is part of an array and of type FLOAT.	47
GetElement()	O	Provides access to an element of the container element.	47
getLong()	I	Returns the value of the specified container element leaf element in Java. The leaf is of type LONG.	47
getLong2()	I	Returns the value of the specified container element leaf element in Java. The leaf is part of an array and of type LONG.	47
getString()	C	Returns the value of the specified container element leaf element in Java. The leaf is of type STRING.	47
getString2()	C	Returns the value of the specified container element leaf element in Java. The leaf is part of an array and of type STRING.	47
IsArray()	B	Indicates whether the container element is an array.	41
IsLeaf()	B	Indicates whether the container element is a leaf.	41
IsStruct()	B	Indicates whether the container element is a structure itself.	41
LeafCount()	I	Returns the number of leaf elements of the container element.	41
Leaves()	M	Returns all leaf elements of the container element.	41

Accessor methods	Type	Description	Page
LongValue()	I	Returns the value of the specified container element leaf element in C or COBOL. The leaf is of type LONG.	54
MemberCount()	I	Returns the number of structural members in the container element.	41
Name()	C	Returns the name of the container element.	41
StringLength()	I	Returns the length of the value of the specified container element leaf element in C or COBOL. The leaf is of type STRING.	54
StringValue()	C	Returns the value of the specified container element leaf element in C or COBOL. The leaf is of type STRING..	54
StructMembers()	M	Returns the structural members of the container element.	41
Type()	C	Returns the type of the container element, that is, the data structure name.	41
Value()	C/I/F/N	Returns the value of the specified container element leaf element in C++.	54

ContainerElementVector

A container element vector represents the result of a query for container elements in C or COBOL.

Refer to “C and COBOL vector accessor functions” on page 21 for detailed descriptions of vector functions.

Vector methods	Description
Deallocate()	Deallocates a container element vector object.
FirstElement()	Returns the first element of the container element vector.
NextElement()	Returns the next element of the container element vector.
Size()	Returns the number of elements in the container element vector.

ControlConnectorInstance

A control connector instance object represents a control connector between two activity instances and its state.

Refer to “Basic API calls” on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs a control connector instance object.	71
Copy()	Allocates and initializes the storage for a control connector instance object by copying.	74
Deallocate()	Deallocates the storage for a control connector instance object.	75
destructor()	Destructs a control connector instance object.	75

Basic methods	Description	Page
Equal()	Compares two control connector instance objects on the basis of their source and target activity instances.	73
IsEmpty()	Indicates whether control connector instance information is not available.	76
Kind()	States the kind of the control connector instance, whether it is a transition condition or the "otherwise" connector.	76
operator=()	Assigns a control connector instance object to this one.	73
operator==()	Compares two control connector instance objects on the basis of their source and target activity instances.	73

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. All properties are primary properties.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
BendPoints()	M	Returns the bend points of the control connector instance.	109
Name()	C	Returns the name associated with the control connector instance.	108
NameIsNull()	B	Indicates whether a name is set.	111
PersistentOidOfSourceActivity()	C	Returns the object ID of the activity instance which is the source of this control connector instance.	108
PersistentOidOfTargetActivity()	C	Returns the object ID of the activity instance which is the target of this control connector instance.	108
State()	E	Returns the state of the control connector instance, whether it is evaluated, and the result of evaluation.	88
TransitionCondition()	C	Returns the transition condition of the control connector instance.	108
TransitionConditionIsNull()	B	Indicates whether a transition condition is set.	111

ControlConnectorInstanceVector

A control connector instance vector represents the result of a query for control connector instances in C or COBOL.

Refer to "C and COBOL vector accessor functions" on page 21 for detailed descriptions of vector access functions.

Accessor methods	Description
Deallocate()	Deallocates a control connector instance vector object.

Accessor methods	Description
FirstElement()	Returns the first element of the control connector instance vector.
NextElement()	Returns the next element of the control connector instance vector.
Size()	Returns the number of elements in the control connector instance vector.

Date and Time (FmcDateTime/FmcjCDateTime/Calendar)

An FmcjDateTime object represents date and time values in C++. An FmcjCDateTime structure represents date and time values in C or COBOL. Java uses a Calendar object.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls. The following methods are only available in C++.

Basic methods	Description	Page
constructor()	Constructs a date/time object.	71
destructor()	Destructs a date/time object.	75
operator=()	Assigns a date/time object to another one.	73
operator==()	Compares two date/time objects.	73
operator string()	Returns the string representation of the date/time object.	108
IsEmpty()	Indicates whether date/time information is not available.	76

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. Because a date/time object represents a supporting object on the client only, the distinction between primary and secondary attributes is not applicable.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

The following methods are only available in C++.

Accessor methods	Type	Description	Page
Day()	I	Returns the day of the date/time object.	107
Hour()	I	Returns the hours of the date/time object.	107
Minute()	I	Returns the minutes of the date/time object.	107
Month()	I	Returns the month of the date/time object.	107
Second()	I	Returns the seconds of the date/time object.	107
Year()	I	Returns the year of the date/time object.	107

The following functions are only available in C and COBOL.

Accessor functions	Type	Description	Page
FmcjDateTimeAsString()	C	Returns the string representation of the date/time structure.	108
FmcjDateTimeCurrentTime()	D	Returns the current date/time.	88
FmcjDateTimeIsValid()	B	Indicates whether the passed date/time is a valid date/time; must be greater than or equal to 1970-1-1 12:00 (yyyy-mm-dd hh:mm).	87

DllOptions

A DllOptions object represents the program implementation definitions for a dynamic link library.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs a DLL options object.	71
Copy()	Allocates and initializes the storage for a DLL options object by copying.	74
Deallocate()	Deallocates the storage for a DLL options object.	75
destructor()	Destructs a DLL options object.	75
IsEmpty()	Indicates whether DLL options information is not available.	76
operator=()	Assigns a DLL options object to this one.	73

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. All properties are primary properties.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
EntryPointName()	C	Returns the name of the entry point of the DLL.	108
ExecuteFenced()	B	States whether the DLL should run in a separate address space.	87
ExecuteFencedIsNull()	B	Indicates whether execute fended is set.	111
KeepLoaded()	B	States whether the DLL should stay loaded.	87
KeepLoadedIsNull()	B	Indicates whether keep loaded is set.	111
PathAndFileName()	C	Returns the path and file name of the DLL.	108

ExecutionAgent

An ExecutionAgent object (Java) represents an MQSeries Workflow program execution agent.

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. Because the following information is retrieved from the program execution agent, a distinction between primary and secondary properties is not applicable.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
ProgramID()	C	Returns the program identification by which the invoked activity implementation is known to the program execution agent.	108
RemoteUserID()	C	Returns the user identification on whose behalf the activity implementation which started this program was originally started.	108
UserID()	C	Returns the user identification on whose behalf the activity implementation was started.	108

Refer to "Activity implementation API calls" on page 122 for detailed descriptions of activity implementation API calls.

Activity implementation methods	Description	Page
InContainer()	Accesses the input container from within an activity implementation in Java.	303
OutContainer()	Accesses the output container from within an activity implementation in Java.	305
RemoteInContainer()	Accesses the input container from within a program started by an activity implementation in Java.	307
RemoteOutContainer()	Accesses the output container from within a program started by an activity implementation in Java.	308
SetOutContainer()	Sets the output container from within an activity implementation in Java.	310
SetRemoteOutContainer()	Sets the output container from within a program started by an activity implementation in Java.	312

ExecutionData

An Execution data object represents data sent from an MQSeries Workflow execution server.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs an Execution data object.	71
Copy()	Allocates and initializes the storage for an Execution data object by copying.	74
Deallocate()	Deallocates the storage for an execution data object.	75

Basic methods	Description	Page
destructor()	Destructs an execution data object.	75
IsEmpty()	Indicates whether execution data information is not available.	76
Kind()	Returns the kind of the data, whether it is describing a work item creation, deletion, and so on.	76
operator=()	Assigns an execution data object to this one.	73

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. All properties are primary properties.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
ActivityInstanceNotificationFromData()	P	Creates an activity instance notification from the execution data.	111
ErrorFromData()	P	Creates an error description object from the execution data.	111
IsError()	B	States whether the execution data describes an erroneous situation.	87
PersistentOid()	C	Returns a representation of the object ID of the object described by the execution data.	108
ProcessInstanceNotificationFromData()	P	Creates a process instance notification from the execution data.	111
ReadOnlyContainerFromData()	P	Creates a container object from the execution data.	111
WorkitemFromData()	P	Creates a work item from the execution data.	111
UserContext()	C	Returns the user context.	108
UserContextIsNull()	B	States whether a user context had been specified.	111

ExecutionService

An ExecutionService object represents a user session to an execution server.

Note: All API calls provided by FmcjService are also applicable.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
Allocate()	Allocates the storage for an execution service object. The execution server to connect to is taken from the MQSeries Workflow user's or configuration profile in the currently set configuration.	71
AllocateForSystem()	Allocates the storage for the specified execution service object. The execution server to connect to is taken from the specified parameters in the currently set configuration.	71
AllocateForGroup()	Allocates the storage for the specified execution service object. The execution server to connect to can be any system within the specified system group in the currently set configuration.	71
constructor()	Constructs an execution service object.	71
Copy()	Allocates and initializes the storage for an execution service object by copying.	74
Deallocate()	Deallocates the storage for an execution service object.	75
destructor()	Destructs an execution service object.	75
Equal()	Compares two execution service objects if they represent the same session.	73
operator=()	Assigns an execution service object to this one.	73
operator==()	Compares two execution service objects if they represent the same session.	73

Refer to "Action API calls" on page 122 for detailed descriptions of action API calls.

Action methods	Description	Page
CreateProcessInstanceList()	Creates a new process instance list on the execution server.	315
CreateProcessTemplateList()	Creates a new process template list on the execution server.	321
CreateWorklist()	Creates a new worklist on the execution server.	326
Logoff()	Logs off from the connected execution server.	333
Logon()	Logs on to the execution server.	334
Logon2()	Logs on to the execution server in Java and provides additional parameters.	334
persistentActivityInstance Notification()	Retrieves the activity instance notification specified by the passed object identification in the Java API.	292
persistentProcessInstance()	Retrieves the process instance specified by the passed object identification in the Java API.	426

Action methods	Description	Page
persistentProcessInstance Notification()	Retrieves the process instance notification specified by the passed object identification in the Java API.	446
persistentProcessTemplate()	Retrieves the process template specified by the passed object identification in the Java API.	467
persistentWorkItem()	Retrieves the work item specified by the passed object identification in the Java API.	504
QueryActivityInstance Notifications()	Retrieves the activity instance notifications the logged-on user has access to.	341
QueryItems()	Retrieves the work items or notifications the logged-on user has access to.	347
QueryProcessInstanceLists()	Retrieves the process instance lists the logged-on user has access to.	353
QueryProcessInstance Notifications()	Retrieves the process instance notifications the logged-on user has access to.	355
QueryProcessInstances()	Retrieves the process instances the logged-on user has access to.	361
QueryProcessTemplateLists()	Retrieves the process template lists the logged-on user has access to.	366
QueryProcessTemplates()	Retrieves the process templates the logged-on user has access to.	368
QueryWorkitems()	Retrieves the work items the logged-on user has access to.	372
QueryWorklists()	Retrieves the worklists the logged-on user has access to.	379
Receive()	Receives execution data sent by an MQSeries Workflow execution server.	381
TerminateReceive()	Places information in the client input queue to indicate that receiving execution data sent by an MQSeries Workflow execution server can end.	386

Refer to “Activity implementation API calls” on page 122 for detailed descriptions of activity implementation API calls.

Activity implementation methods	Description	Page
Passthrough()	Establishes a session between an activity implementation and an execution server.	339
RemotePassthrough()	Establishes a session between a program started by an activity implementation and an execution server.	384

ExeOptions

An ExeOptions object represents the program implementation definitions for an executable.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs an EXE options object.	71
Copy()	Allocates and initializes the storage for an EXE options object by copying.	74
Deallocate()	Deallocates the storage for an EXE options object.	75
destructor()	Destructs an EXE options object.	75
operator=()	Assigns an EXE options object to this one.	73
IsEmpty()	Indicates whether EXE options information is not available.	76

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. All properties are primary properties.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
AutomaticClose()	B	States whether the window in which the EXE starts should close when the EXE ends.	87
AutomaticCloseIsNull()	B	Indicates whether automatic close is set.	111
Environment()	C	States the environment settings for the EXE.	108
EnvironmentIsNull()	B	Indicates whether an environment is set.	111
InheritEnvironment()	B	States whether the environment settings should be merged with the operating system environment settings.	87
PathAndFileName()	C	Returns the path and file name of the EXE.	108
RunInXTerm()	B	States whether the EXE should start in a separate xterm.	87
RunInXTermIsNull()	B	Indicates whether run in xterm is set.	111
StartInForeGround()	B	States whether the EXE should start in the foreground.	87
StartInForeGroundIsNull()	B	Indicates whether start in foreground is set.	111
WindowStyle()	O	States the initial window style.	109
WindowStyleIsNull()	B	Indicates whether a window style is set.	111
WorkingDirectoryName()	C	States the working directory for the EXE.	108
WorkingDirectoryNameIsNull()	B	Indicates whether a working directory is set.	111

ExternalOptions

An ExternalOptions object represents the program implementation definitions for an external service.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs an External options object.	71
Copy()	Allocates and initializes the storage for an External options object by copying.	74
Deallocate()	Deallocates the storage for an External options object.	75
destructor()	Destructs an External options object.	75
operator=()	Assigns an External options object to this one.	73
IsEmpty()	Indicates whether External options information is not available.	76

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. All properties are primary properties.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
BackwardMappingFormat()	C	Specifies the format of the mapping from the structure the executable uses to an MQSeries Workflow container.	108
BackwardMappingFormatIsNull()	B	Indicates whether a backward mapping format is set.	111
BackwardMappingParameters()	M	Returns backward mapping parameters, if any.	109
BackwardMappingParametersIsNull()	B	Indicates whether backward mapping parameters are set.	111
CodePage()	I	Specifies the code page of the service.	107
CodePageIsNull()	B	Indicates whether a code page is set.	111
ExecutableName()	C	Specifies the executable to be invoked by the invocation type and service.	108
ExecutableType()	C	Identifes the type of the executable.	108
ForwardMappingFormat()	C	Specifies the format for the mapping from an MQSeries Workflow container to the structure the executable uses.	108

Accessor methods	Type	Description	Page
ForwardMappingFormatIsNull()	B	Indicates whether a forward mapping format is set.	111
ForwardMappingParameters()	M	Returns forward mapping parameters, if any.	109
ForwardMappingParametersIsNull()	B	Indicates whether forward mapping parameters are set.	111
InvocationType()	C	Specifies the invocation mechanism to invoke the executable on the service.	108
IsLocalUser()	B	Returns whether a local user is to be resolved instead of using the MQSeries Workflow user ID.	87
IsMappingRoutineCall()	B	Specifies whether forward and backward mapping routines are to be called.	87
IsSecurityRoutineCall()	B	Specifies whether a security routine is to be called.	87
MappingType()	C	Identifies the type of mapping that should occur.	108
MappingTypeIsNull()	B	Indicates whether a mapping type is set.	111
ServiceName()	C	Identifies the service that is to be called.	108
ServiceType()	C	Identifies the type of service to be called, for example, CICS(R) or IMS(TM).	108
TimeoutPeriod()	E	Specifies how long the program execution server should wait for a response from the started service: forever, a time period, or never.	88
TimeoutInterval()	I	Specifies the timeout interval.	107
TimeoutIntervalIsNull()	B	Indicates whether a timeout interval is set.	111

FmcError/FmcjError

An FmcError or FmcjError object represents a description of the reason why a work item or activity instance is in state InError. It also describes an error returned as an asynchronous response.

Refer to “Basic API calls” on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs an Error object.	71
Copy()	Allocates and initializes the storage for an Error object by copying.	74
Deallocate()	Deallocates the storage for an Error object.	75
destructor()	Destructs an Error object.	75

Basic methods	Description	Page
Equal()	Compares two Error objects on the basis of their return codes and parameters.	73
IsEmpty()	Indicates whether Error information is not available.	76
operator=()	Assigns an Error object to this one.	73
operator==()	Compares two Error objects on the basis of their return codes and parameters.	73

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. All properties are primary properties.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
MessageText()	C	Returns the error as a formatted message (in the local language if applicable).	108
Parameters()	M	Returns the parameters of the error; these are to be incorporated into the message text.	109
Rc()	I	Returns the return code remembered in the error object.	107

FmcException

An FmcException object represents a description of an exception thrown by Java.

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. All properties are primary properties.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
MessageText()	C	Returns the exception as a formatted message (in the local language if applicable).	108
nestedException()	-	Returns an exception thrown by the communication layer. **Note:** The nested exception can be inspected by (down-)casting to either org.omg.CORBA.SystemException or to java.rmi.RemoteException depending on the communication protocol used. However, doing so will make the client code protocol-dependent (unless it deals with both cases). When using local bindings the nested exception will always be null.	108

Accessor methods	Type	Description	Page
origin()	C	Returns the module that threw the exception.	108
Parameters()	M	Returns the parameters of the error; these are already incorporated into the message text.	109
Rc()	I	Returns the return code remembered in the error object.	107

Global

A Global object serves to group global MQSeries Workflow API calls.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description
Connect()	Initializes the API in the current thread.
Disconnect()	Deinitializes the API in the current thread.

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. All properties are primary properties.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
ConfigurationID()	C	Returns the configuration ID to be used for profile access.	108
SetConfigurationID()	C	Sets the configuration ID to be used for profile access. Can only be set before the first profile usage.	108

ImplementationData

An ImplementationData object represents the program implementation definitions.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs an implementation data object.	71
Copy()	Allocates and initializes the storage for an implementation data object by copying.	74
Deallocate()	Deallocates the storage for an implementation data object.	75
destructor()	Destructs an implementation data object.	75
operator=()	Assigns an implementation data object to this one.	73
IsEmpty()	Indicates whether implementation data information is not available.	76
Kind()	States the actual kind of the implementation data, whether it is a DLL or an EXE.	76

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. All properties are primary properties.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
CommandLineParameters()	M	Returns the command line parameters to be passed to the invoked program.	109
CommandLineParametersIsNull()	B	Indicates whether command line parameters are set.	111
DllOptions()	P	Returns the description of a DLL, if the implementation is a DLL.	111
ExeOptions()	P	Returns the description of an EXE, if the implementation is an EXE.	111
ExternalOptions()	P	Returns the description of external options, if the implementation is an external service.	111
options()	P	Returns the description of an EXE, a DLL, or an external service in Java.	111
Platform()	E	Returns the operating system platform this implementation data describes.	88

Item

An item represents a work item, an activity instance notification, or a process instance notification.

Note: This means that all API calls of an item are also applicable to work items, activity instance notifications, and process instance notifications.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs an item object.	71
Copy()	Allocates and initializes the storage for an item object by copying.	74
Deallocate()	Deallocates the storage for an item object.	75
destructor()	Destructs an item object.	75
Equal()	Compares two items.	73
IsComplete()	Indicates whether the complete item information is available.	75
IsEmpty()	Indicates whether item information is not available.	76
Kind()	States the actual kind of the item, whether it is a work item or some kind of notification.	76

Basic methods	Description	Page
operator=()	Assigns an item to this one.	73
operator==()	Compares two items.	73

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor and mutator API calls.

Note: The value in the **Set** column shows if this attribute is a primary attribute (P) and set immediately when items are queried or if this attribute is a secondary attribute (S) and set only after the refresh of a specific item.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Set/ Type	Description	Page
Category()	P/C	Returns the process category of the item.	108
CategoryIsNull()	P/B	Indicates whether a category is set.	111
CreationTime()	P/D	Returns the creation time of the item.	88
Description()	P/C	Returns the description of the item.	108
DescriptionIsNull()	P/B	Indicates whether a description is set.	111
Documentation()	S/C	Returns the documentation of the item.	108
DocumentationIsNull()	S/B	Indicates whether a documentation is set.	111
EndTime()	S/D	Returns the ending time of the item.	88
EndTimeIsNull()	S/B	Indicates whether an end time is set.	111
Icon()	P/C	Returns the icon associated with the item.	108
InContainerName()	S/C	Returns the name of the input container of the item.	108
LastModificationTime()	P/D	Returns the last time a primary attribute of the item was changed.	88
Name()	P/C	Returns the name of the item. in C or COBOL, a work item or activity instance notification requires a buffer of at least 33 bytes, a process instance notification a buffer of at least 64 bytes.	108
OutContainerName()	S/C	Returns the name of the output container of the item.	108
Owner()	P/C	Returns the user ID of the owner of the item.	108

Accessor methods	Set/ Type	Description	Page
PersistentOid()	P/C	Returns a representation of the object identification of the item.	108
ProcessAdmin()	S/C	Returns the user ID of the process administrator of the item.	108
ProcessInstanceName()	P/C	Returns the name of the process instance the item is part of.	108
ProcessInstanceState()	P/E	Returns the state of the process instance the item is part of.	88
ProcessInstanceSystemGroupName()	S/C	Returns the name of the system group of the process instance the item is part of.	108
ProcessInstanceSystemName()	S/C	Returns the name of the system of the process instance the item is part of.	108
ReceivedAs()	P/E	Returns the reason why the item was received.	88
ReceivedTime()	P/D	Returns the time when the item was received.	88
StartTime()	P/D	Returns the start time of the item.	88
StartTimeIsNull()	P/B	Indicates whether a start time is set.	111

Mutator methods	Description	Page
Update()	Updates the item with the execution data sent by an MQSeries Workflow execution server. The object IDs of the item and of the object described by the execution data must match.	114

Refer to "Action API calls" on page 122 for detailed descriptions of action API calls.

Action methods	Description	Page
Delete()	Deletes an item.	388
ObtainProcessInstanceMonitor()	Retrieves the process instance monitor for the process instance the item is part of.	390
ProcessInstance()	Retrieves the process instance the item is part of.	392
Refresh()	Retrieves the complete information of the item.	394
SetDescription()	Sets the description of the item.	396
SetName()	Sets the name of the item.	398
Transfer()	Transfers an item to the specified user.	400

ItemVector

An item vector represents the result of a query for items in C or COBOL.

Refer to "C and COBOL vector accessor functions" on page 21 for detailed descriptions of vector access functions.

Accessor methods	Description
Deallocate()	Deallocates an item vector object.
FirstElement()	Returns the first element of the item vector.
NextElement()	Returns the next element of the item vector.
Size()	Returns the number of elements in the item vector.

Message

A message object serves to access the MQSeries Workflow provided message catalog.

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself. The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
MessageText()	C	Returns a formatted message (in the local language if applicable) based on the message ID. Any parameters passed will be incorporated.	108

PersistentList

A persistent list object represents a persistent list definition.

Note: All API calls of a persistent list are also applicable to process instance lists, process template lists, and worklists.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
IsEmpty()	Indicates whether persistent list information is not available.	76

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. All properties are primary properties.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
Description()	C	Returns the description of the persistent list.	108
DescriptionIsNull()	B	Indicates whether a description is set.	111

Accessor methods	Type	Description	Page
Filter()	C	Returns the filter of the persistent list.	108
FilterIsNull()	B	Indicates whether a filter is set.	111
Name()	C	Returns the name of the persistent list.	108
OwnerOfList()	C	Returns the user ID of the owner of the persistent list.	108
OwnerOfListIsNull()	B	Indicates whether an owner is set; a public list does not have an owner.	111
SortCriteria()	C	Returns the sort criteria of the persistent list.	108
SortCriteriaIsNull()	B	Indicates whether sort criteria are set.	111
Threshold()	I	Returns the threshold of the persistent list.	107
ThresholdIsNull()	B	Indicates whether a threshold is set.	111
Type()	C	Returns the type of the persistent list, whether it is a public or private list.	108

Refer to “Action API calls” on page 122 for detailed descriptions of action API calls.

Action methods	Description	Page
Delete()	Deletes the persistent list.	403
Refresh()	Refreshes the persistent list.	404
SetDescription()	Sets the description of the persistent list.	406
SetFilter()	Sets the filter of the persistent list.	408
SetSortCriteria()	Sets the sort criteria of the persistent list.	410
SetThreshold()	Sets the threshold of the persistent list.	412

Person

A person object represents the settings of the logged-on user.

Refer to “Basic API calls” on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs a person object.	71
Copy()	Allocates and initializes the storage for a person object by copying.	74
Deallocate()	Deallocates the storage for a person object.	75
destructor()	Destructs a person object.	75
Equal()	Compares two persons.	73
operator=()	Assigns a person to this one.	73
operator==()	Compares two persons.	73
IsComplete()	Indicates whether the complete person information is available.	75
IsEmpty()	Indicates whether person information is not available.	76

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls.

Note: The value in the **Set** column shows if this attribute is a primary attribute (P) and set immediately when persons are queried or if this attribute is a secondary attribute (S) and set only after the refresh of a specific person.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Set/ Type	Description	Page
CategoriesAuthorizedFor()	P/M	Returns the categories the person is authorized for with basic or with administration rights. If the person is authorized for all categories as administrator, no category is returned here. If the person is authorized for all categories with basic rights, categories authorized with administration rights are returned here.	109
CategoriesAuthorizedForAsAdmin()	P/M	Returns the categories the person is authorized for with administration rights. If the person is authorized for all categories with administration rights, no category is returned here.	109
Description()	P/C	Returns the description of the person.	108
DescriptionIsNull()	P/B	Indicates whether a description is set.	111
FirstName()	P/C	Returns the first name of the person.	108
FirstNameIsNull()	P/B	Indicates whether a first name is set.	111
IsAbsent()	P/B	Indicates whether the person is absent.	87
IsAdminForCategory()	P/B	Indicates whether the person has administrator rights for the specified category. Returns false if the category does not exist. If the person is authorized for all categories as administrator, then true is returned independent of the category existence.	87

Accessor methods	Set/ Type	Description	Page
IsAdministrator()	S/B	Indicates whether the person is an administrator.	87
IsAuthorizedForAllCategories()	P/B	Indicates whether the person is said to be authorized for all categories either with basic and/or administration rights.	87
IsAuthorizedForAllCategoriesAsAdmin()	P/B	Indicates whether the person is said to be authorized for all categories as administrator.	87
IsAuthorizedForAllPersons()	P/B	Indicates whether the person is authorized to see the items of all persons.	87
IsAuthorizedForAuthorizationDefinition()	P/B	Indicates whether the person is authorized to define authorizations.	87
IsAuthorizedForOperationAdministration()	P/B	Indicates whether the person is authorized for operational administrations.	87
IsAuthorizedForProcessDefinition()	P/B	Indicates whether the person is authorized to define process models.	87
IsAuthorizedForStaffDefinition()	P/B	Indicates whether the person is authorized to define persons.	87
IsAuthorizedForTopologyDefinition()	P/B	Indicates whether the person is authorized to define topological data.	87
IsManager()	S/B	Indicates whether the person is a manager.	87
IsResetAbsence()	P/B	Indicates whether the absence flag should be reset when the person logs on.	87
LastName()	P/C	Returns the last name of the person.	108
LastNameIsNull()	P/B	Indicates whether a last name is set.	111
Level()	P/I	Returns the level of the person.	107
Manager()	S/C	Returns the user identification of the person's manager.	108
ManagerIsNull()	S/B	Indicates whether the person's manager is set.	111
MiddleName()	P/C	Returns the middle name of the person.	108
MiddleNameIsNull()	P/B	Indicates whether a middle name is set.	111

Accessor methods	Set/ Type	Description	Page
NamesOfManagedOrganizations()	S/M	Returns the names of organizations the person manages.	109
NamesOfRoles()	P/M	Returns the names of roles the person belongs to.	109
NamesOfRolesToCoordinate()	S/M	Returns the names of roles the person can coordinate.	109
OrganizationName()	P/C	Returns the name of the organization the person belongs to.	108
OrganizationNameIsNull()	P/B	Indicates whether an organization name is set.	111
PersonID()	P/C	Returns the person ID of the person.	108
PersonIDIsNull()	P/B	Indicates whether a person ID is set.	111
PersonsAuthorizedFor()	P/M	Returns the persons for whom this person is authorized either explicitly or by being a substitute. If the person is authorized for **all** other persons, then no person is returned here.	109
PersonsAuthorizedForMe()	S/M	Returns the persons who are authorized for this person.	109
PersonsToStandInFor()	S/M	Returns the persons for whom this person stands in.	109
Phone()	P/C	Returns the phone number of the person.	108
PhoneIsNull()	P/B	Indicates whether a phone is set.	111
SecondPhone()	P/C	Returns the alternate phone number of the person.	108
SecondPhoneIsNull()	P/B	Indicates whether an alternate phone is set.	111
Substitute()	P/C	Returns the substitute of the person.	108
SubstituteIsNull()	P/B	Indicates whether a substitute is set.	111
SystemName()	P/C	Returns the home system of the person.	108
UserID()	P/C	Returns the user identification of the person.	108

Refer to “Action API calls” on page 122 for detailed descriptions of action API calls.

Action methods	Description	Page
Refresh()	Retrieves the complete person information from the server.	414
SetAbsence()	Sets the absent flag of the logged-on user to the specified value.	416
SetSubstitute()	Sets the substitute of the logged-on user to the specified value.	417

Point

A point object represents a bend point of a control connector.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs a point object.	71
Copy()	Allocates and initializes the storage for a point object by copying.	74
Deallocate()	Deallocates the storage for a point object.	75
destructor()	Destructs a point object.	75
Equal()	Compares two point objects on the basis of their contents.	73
IsEmpty()	Indicates whether point information is not available.	76
operator=()	Assigns a point object to this one.	73
operator==()	Compares two point objects on the basis of their contents.	73

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. All properties are primary properties.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
XPosition()	I	Returns the x-coordinate of the point.	107
YPosition()	I	Returns the y-coordinate of the point.	107

PointVector

A point vector represents the result of a query for points in C or COBOL.

Refer to "C and COBOL vector accessor functions" on page 21 for detailed descriptions of vector access functions.

Accessor methods	Description
Deallocate()	Deallocates a point vector object.
FirstElement()	Returns the first element of the point vector.
NextElement()	Returns the next element of the point vector.

Accessor methods	Description
Size()	Returns the number of elements in the point vector.

ProcessInstance

A process instance object represents an instance of a workflow process template.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs a process instance object.	71
Copy()	Allocates and initializes the storage for a process instance object by copying.	74
Deallocate()	Deallocates the storage for a process instance object.	75
destructor()	Destructs a process instance object.	75
Equal()	Compares two process instances.	73
IsComplete()	Indicates whether the complete process instance information is available.	75
IsEmpty()	Indicates whether process instance information is not available.	76
operator=()	Assigns a process instance to this one.	73
operator==()	Compares two process instances.	73

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls.

Note: The value in the **Set** column shows if this attribute is a primary attribute (P) and set immediately when process instances are queried or if this attribute is a secondary attribute (S) and set only after the refresh of a specific process instance.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Set/ Type	Description	Page
AuditMode()	S/E	Returns the audit mode of the process instance.	88
Category()	P/C	Returns the category of the process instance.	108
CategoryIsNull()	P/B	Indicates whether a category is set.	111
CreationTime()	S/D	Returns the creation time of the process instance.	88
Creator()	S/C	Returns the creator of the process instance.	108
Description()	P/C	Returns the description of the process instance.	108

Accessor methods	Set/ Type	Description	Page
DescriptionIsNull()	P/B	Indicates whether a description is set.	111
Documentation()	S/C	Returns the documentation of the process instance.	108
DocumentationIsNull()	S/B	Indicates whether a documentation is set.	111
EndTime()	S/D	Returns the end time of the process instance.	88
EndTimeIsNull()	S/B	Indicates whether an end time is set.	111
Icon()	P/C	Returns the icon associated with the process instance.	108
InContainerName()	S/C	Returns the name of the input container of the process instance.	108
InContainerNeeded()	P/B	Indicates whether an input container is needed to start the process instance. An input container is needed when • There is a mapping to some other container. • Staff assignment data is taken from it. • Notification related data is taken from it. • A transaction or exit condition refers to a container element. • A description refers to a container element. • *Prompt for data at process start* is set for the process model.	87
LastModificationTime()	P/D	Returns the last time a primary attribute of the process instance was changed.	88
LastStateChangeTime()	P/D	Returns the last time the state of the process instance was changed.	88
Name()	P/C	Returns the name of the process instance.	108
NotificationTime()	S/D	Returns the notification time of the process instance.	88
NotificationTimeIsNull()	S/B	Indicates whether a notification time is set.	111
NotifiedPerson()	S/C	Returns the person who received the notification.	108
NotifiedPersonIsNull()	S/B	Indicates whether a notified person is set.	111
OrganizationName()	S/C	Returns the name of the organization of the process instance.	108

Accessor methods	Set/ Type	Description	Page
OrganizationNameIsNull()	S/B	Indicates whether an organization name is set.	111
OutContainerName()	S/C	Returns the name of the output container of the process instance.	108
ParentName()	P/C	Returns the name of the parent process instance of this process instance.	108
ParentNameIsNull()	P/B	Indicates whether a parent name is set.	111
PersistentOid()	P/C	Returns a representation of the object identification of the process instance.	108
ProcessAdmin()	S/C	Returns the user ID of the process administrator of the process instance.	108
ProcessAdminIsNull()	S/B	Indicates whether a process administrator is set.	111
ProcessTemplateName()	P/C	Returns the name of the process template the process instance is derived from.	108
RoleName()	S/C	Returns the name of the role of the process instance.	108
RoleNameIsNull()	S/B	Indicates whether a role is set.	111
Starter()	S/C	Returns the starter of the process instance.	108
StarterIsNull()	S/B	Indicates whether a starter is set.	111
StartTime()	S/D	Returns the start time of the process instance.	88
StartTimeIsNull()	S/B	Indicates whether a start time is set.	111
State()	P/E	Returns the state of the process instance.	88
StateOfNotification()	S/E	Returns the notification state of the process instance.	88
SuspensionExpirationTime()	P/D	Returns the suspension expiration time of the process instance.	88
SuspensionExpirationTimeIsNull()	P/B	Indicates whether the suspension expiration time is set.	111
SuspensionTime()	P/D	Returns the time the process instance was suspended.	88
SuspensionTimeIsNull()	P/B	Indicates whether the suspension time is set.	111
SystemGroupName()	P/C	Returns the name of the system group where the process instance runs.	108
SystemName()	P/C	Returns the name of the system where the process instance runs.	108

Accessor methods	Set/ Type	Description	Page
TopLevelName()	P/C	Returns the name of the top level process instance of this process instance.	108

Refer to "Action API calls" on page 122 for detailed descriptions of action API calls.

Action methods	Description	Page
Delete()	Deletes the process instance.	420
InContainer()	Retrieves the input container of the process instance.	421
ObtainMonitor()	Retrieves the process instance monitor for the process instance.	424
PersistentObject()	Retrieves the process instance specified by the passed object identification.	426
Refresh()	Retrieves the complete information of the process instance.	428
Restart()	Restarts the process instance.	430
Resume()	Resumes the execution of a suspended process instance.	431
SetDescription()	Sets the description of the process instance.	433
SetName()	Sets the name of the process instance.	435
Start()	Starts the process instance.	437
Start2()	Starts the process instance in Java and provides an input container.	437
Suspend()	Suspends the process instance.	439
Suspend2()	Suspends the process instance in Java until the specified calendar date.	439
SuspendUntil()	Suspends the process instance until the specified time.	439
Terminate()	Terminates the process instance.	441

ProcessInstanceList

A process instance list represents a group of process instances.

Note: All API calls of a persistent list are also applicable to process instance lists.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs a process instance list object.	71
Copy()	Allocates and initializes the storage for a process instance list object by copying.	74
Deallocate()	Deallocates the storage for a process instance list object.	75
destructor()	Destructs a process instance list object.	75
Equal()	Compares two process instance lists.	73

Basic methods	Description	Page
operator=()	Assigns a process instance list to this one.	73
operator==()	Compares two process instance lists.	73

Refer to "Action API calls" on page 122 for detailed descriptions of action API calls.

Action methods	Description	Page
QueryProcessInstances()	Retrieves the process instances qualifying via the process instance list.	443

ProcessInstanceListVector

A process instance list vector represents the result of a query for process instance lists in C or COBOL.

Refer to "C and COBOL vector accessor functions" on page 21 for detailed descriptions of vector access functions.

Accessor methods	Description
Deallocate()	Deallocates a process instance list vector object.
FirstElement()	Returns the first element of the process instance list vector.
NextElement()	Returns the next element of the process instance list vector.
Size()	Returns the number of elements in the process instance list vector.

ProcessInstanceMonitor

A process instance monitor object represents a monitor of a process instance.

Note: All API calls of FmcjBlockInstanceMonitor are also applicable to process instance monitors.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
Deallocate()	Deallocates the storage for a process instance monitor object. All block instance monitors contained are also deallocated.	75
destructor()	Destructs a process instance monitor object. All block instance monitors contained are also destructed.	75

ProcessInstanceNotification

A process instance notification represents a notification raised for a process instance.

Note: All API calls for FmcjItem are also applicable to process instance notifications.

API classes and objects

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs a process instance notification object.	71
Copy()	Allocates and initializes the storage for a process instance notification object by copying.	74
Deallocate()	Deallocates the storage for a process instance notification object.	75
destructor()	Destructs a process instance notification object.	75
Kind()	In C++, states that the object is a process instance notification.	76
operator=()	Assigns a process instance notification to this one.	73
operator==()	Compares two process instance notifications.	73

Refer to "Action API calls" on page 122 for detailed descriptions of action API calls.

Action methods	Description	Page
PersistentObject()	Retrieves the specified process instance notification.	446

ProcessInstanceNotificationVector

A process instance notification vector represents the result of a query for process instance notifications in C or COBOL.

Refer to "C and COBOL vector accessor functions" on page 21 for detailed descriptions of vector access functions.

Accessor methods	Description
Deallocate()	Deallocates a process instance notification vector object.
FirstElement()	Returns the first element of the process instance notification vector.
NextElement()	Returns the next element of the process instance notification vector.
Size()	Returns the number of elements in the process instance notification vector.

ProcessInstanceVector

A process instance vector represents the result of a query for process instances in C or COBOL.

Refer to "C and COBOL vector accessor functions" on page 21 for detailed descriptions of vector access functions.

Accessor methods	Description
Deallocate()	Deallocates the storage for a process instance vector object.
FirstElement()	Returns the first element of the process instance vector.

Accessor methods	Description
NextElement()	Returns the next element of the process instance vector.
Size()	Returns the number of elements in the process instance vector.

ProcessTemplate

A process template object represents the Runtime equivalent of a Buildtime workflow process model.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs a process template object.	71
Copy()	Allocates and initializes the storage for a process template object by copying.	74
Deallocate()	Deallocates the storage for a process template object.	75
destructor()	Destructs a process template object.	75
Equal()	Compares two process templates.	73
IsComplete()	Indicates whether the complete process template information is available.	75
IsEmpty()	Indicates whether process template information is not available.	76
operator=()	Assigns a process template to this one.	73
operator==()	Compares two process templates.	73

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls.

Note: The value in the **Set** column shows if this attribute is a primary attribute (P) and set immediately when process templates are queried or if this attribute is a secondary attribute (S) and set only after the refresh of a specific process template.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Set/ Type	Description	Page
AuditMode()	S/E	Returns the audit mode of the process template.	88
Category()	P/C	Returns the category of the process template.	108
CategoryIsNull()	P/B	Indicates whether a category is set.	111
CreationTime()	P/D	Returns the creation time of the process template.	88

Accessor methods	Set/ Type	Description	Page
Description()	P/C	Returns the description of the process template.	108
DescriptionIsNull()	P/B	Indicates whether a description is set.	111
Documentation()	S/C	Returns the documentation of the process template.	108
DocumentationIsNull()	S/B	Indicates whether a documentation is set.	111
Icon()	P/C	Returns the icon associated with the process template.	108
InContainerName()	S/C	Returns the name of the input container of the process template.	108
InContainerNeeded()	P/B	Indicates whether an input container is needed to start an instance of the process template. An input container is needed when • There is a mapping to some other container. • Staff assignment data is taken from it. • Notification related data is taken from it. • A transaction or exit condition refers to a container element. • A description refers to a container element. • *Prompt for data at process start* is set for the process model.	87
LastModificationTime()	P/D	Returns the last time a primary attribute of the process template was changed.	88
Name()	P/C	Returns the name of the process template.	108
OrganizationName()	S/C	Returns the name of the organization of the process template.	108
OrganizationNameIsNull()	S/B	Indicates whether an organization name is set.	111
OutContainerName()	S/C	Returns the name of the output container of the process template.	108
PersistentOid()	P/C	Returns a representation of the object identification of the process template.	108
ProcessAdmin()	S/C	Returns the user ID of the process administrator of an instance of the process template.	108
ProcessAdminIsNull()	S/B	Indicates whether a process administrator is set.	111
RoleName()	S/C	Returns the name of the role of the process template.	108
RoleNameIsNull()	S/B	Indicates whether a role is set.	111
ValidFromTime()	P/D	Returns the time when the process template becomes valid.	88

Refer to "Action API calls" on page 122 for detailed descriptions of action API calls.

Action methods	Description	Page
CreateAndStartInstance()	Creates and starts an instance of the process template.	448
CreateAndStartInstance2()	Creates and starts an instance of the process template in Java and provides an input container.	448
CreateInstance()	Creates an instance of the process template.	453
Delete()	Deletes the specified process template.	456
Delete2()	Deletes the specified process template versions in Java.	456
ExecuteProcessInstance()	Creates and executes an instance from the specified process template.	458
ExecuteProcessInstanceAsync()	Creates and executes an instance from the specified process template without waiting for an answer.	458
InitialInContainer()	Retrieves the initially defined input container of the process template.	465
PersistentObject()	Retrieves the process template specified by the passed object identification.	467
ProgramTemplate()	Retrieves the program template specified by the passed name.	469
Refresh()	Retrieves the complete information of the process template.	471

ProcessTemplateList

A process template list represents a group of process templates.

Note: All API calls of a persistent list are also applicable to process template lists.

Refer to “Basic API calls” on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs a process template list object.	71
Copy()	Allocates and initializes the storage for a process template list object by copying.	74
Deallocate()	Deallocates the storage for a process template list object.	75
Equal()	Compares two process template lists.	73
destructor()	Destructs a process template list object.	75
operator=()	Assigns a process template list to this one.	73
operator==()	Compares two process template lists.	73

Refer to “Action API calls” on page 122 for detailed descriptions of action API calls.

Action methods	Description	Page
QueryProcessTemplates()	Retrieves the process templates qualifying via the process template list.	473

ProcessTemplateListVector

A process template list vector represents the result of a query for process template lists in C or COBOL.

Refer to "C and COBOL vector accessor functions" on page 21 for detailed descriptions of vector access functions.

Accessor methods	Description
Deallocate()	Deallocates a process template list vector object.
FirstElement()	Returns the first element of the process template list vector.
NextElement()	Returns the next element of the process template list vector.
Size()	Returns the number of elements in the process template list vector.

ProcessTemplateVector

A process template vector represents the result of a query for process templates in C or COBOL.

Refer to "C and COBOL vector accessor functions" on page 21 for detailed descriptions of vector access functions.

Accessor methods	Description
Deallocate()	Deallocates the storage for a process template vector object.
FirstElement()	Returns the first element of the process template vector.
NextElement()	Returns the next element of the process template vector.
Size()	Returns the number of elements in the process template vector.

ProgramData

A program data object represents the program implementation definitions. In C++, it privately inherits from ProgramTemplate.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs a program data object.	71
Copy()	Allocates and initializes the storage for a program data object by copying.	74
Deallocate()	Deallocates the storage for a program data object.	75
destructor()	Destructs a program data object.	75
Equal()	Compares two program data objects if they belong to the same work item.	73
IsEmpty()	Indicates whether program data information is not yet available.	76

Basic methods	Description	Page
operator=()	Assigns a program data object to this one.	73
operator==()	Compares two program data objects if they belong to the same work item.	73

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. All properties are primary properties.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
Description()	C	Returns the description of the implementing program.	108
DescriptionIsNull()	B	Indicates whether a description is set.	111
ExecutionMode()	E	States whether the program can participate in global transactions or not.	88
ExecutionUser()	C	Returns the user on whose behalf the program is to be executed.	108
Icon()	C	Returns the icon associated with the implementing program.	108
Implementations()	M	Returns the implementation definitions of the program.	109
InContainer()	P	Returns the input container of the program.	111
IsUnattended()	B	States whether the program can run unattended.	87
OutContainer()	P	Returns the output container of the program.	111
ProgramTrusted()	B	States whether the program can be trusted. Only a trusted program can receive its program ID.	87

ProgramTemplate

A program template object represents the program implementation definitions.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs a program template object.	71
Copy()	Allocates and initializes the storage for a program template object by copying.	74
Deallocate()	Deallocates the storage for a program template object.	75
destructor()	Destructs a program template object.	75
Equal()	Compares two program template objects on the basis of their names and the process template they belong to.	73

Basic methods	Description	Page
IsEmpty()	Indicates whether program template information is not yet available.	76
operator=()	Assigns a program template object to this one.	73
operator==()	Compares two program template objects on the basis of their names and the process template they belong to.	73

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. All properties are primary properties.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
Description()	C	Returns the description of the implementing program.	108
DescriptionIsNull()	B	Indicates whether a description is set.	111
ExecutionMode()	E	States whether the program can participate in global transactions or not.	88
ExecutionUser()	C	Returns the user on whose behalf the program is to be executed.	108
Icon()	C	Returns the icon associated with the implementing program.	108
Implementations()	M	Returns the implementation definitions of the program.	109
InitialInContainer()	P	Returns the initially defined input container of the program.	111
InContainerAccess()	B	States whether the input container is accessed by the program.	87
IsUnattended()	B	States whether the program can run unattended.	87
InitialOutContainer()	P	Returns the initially defined output container of the program.	111
OutContainerAccess()	B	States whether the output container is accessed by the program.	87
ProgramTrusted()	B	States whether the program can be trusted. Only a trusted program can receive its program ID.	87
StructuresFromActivity()	B	States whether the program can handle any container passed to it.	87
ValidFromTime()	P/D	Returns the time when the process template and thus the program template becomes valid.	88

Refer to "Action API calls" on page 122 for detailed descriptions of action API calls.

Action methods	Description	Page
Execute()	Requests the execution of the program by the system's program execution server.	476
Execute2()	Requests the execution of the program by the system's program execution server.	476
ExecuteWithOptions()	Requests the execution of the program by the system's program execution server. The priority of the program can be specified.	476
ExecuteAsync()	Requests the execution of the program by the system's program execution server without waiting for an answer.	476
ExecuteAsync2()	Requests the execution of the program by the system's program execution server without waiting for an answer.	476
ExecuteAsyncWithOptions()	Requests the execution of the program by the system's program execution server without waiting for an answer. The priority of the program can be specified.	476

ReadOnlyContainer

A read-only container represents an input data container of a work item.

Note: All API calls of a container are applicable to read-only containers.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs a read-only container object.	71
Copy()	Allocates and initializes the storage for a read-only container object by copying.	74
Deallocate()	Deallocates the storage for a read-only container object.	75
Equal()	Compares two read-only containers.	73
destructor()	Destructs a read-only container object.	75
operator=()	Assigns a read-only container to this one.	73
operator==()	Compares two read-only containers.	73

ReadWriteContainer

A read/write container represents an input container of a process instance or an output container of a work item.

Note: All API calls of a container are applicable to read/write containers.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs a read/write container object.	71
Copy()	Allocates and initializes the storage for a read/write container object by copying.	74
Deallocate()	Deallocates the storage for a read/write container object.	75

Basic methods	Description	Page
Equal()	Compares two read/write containers.	73
destructor()	Destructs a read/write container object.	75
operator=()	Assigns a read/write container to another one.	73
operator==()	Compares two read/write containers.	73

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls.

The value in the **Type** column states the type of the property set, whether it is a binary (N), a character string (C), a float (F), or an integer (I). The API call declaration can be found at the indicated page.

Accessor methods	Type	Description	Page
SetArrayBinaryValue()	N	Sets the value of the specified container leaf element in C or COBOL. The leaf element is part of an array and of type BINARY.	60
SetArrayFloatValue()	F	Sets the value of the specified container leaf element in C or COBOL. The leaf element is part of an array and of type FLOAT.	60
SetArrayLongValue()	I	Sets the value of the specified container leaf element in C or COBOL. The leaf element is part of an array and of type LONG.	60
SetArrayStringValue()	C	Sets the value of the specified container leaf element in C or COBOL. The leaf element is part of an array and of type STRING.	60
SetBinaryValue()	N	Sets the value of the specified container leaf element in C or COBOL. The leaf element is of type BINARY.	60
SetBuffer()	N	Sets the value of the specified container leaf element in Java. The leaf element is of type BINARY.	60
SetBuffer2()	N	Sets the value of the specified container leaf element in Java. The leaf element is part of an array and of type BINARY.	60
SetDouble()	F	Sets the value of the specified container leaf element in Java. The leaf element is of type FLOAT.	60
SetDouble2()	F	Sets the value of the specified container leaf element in Java. The leaf element is part of an array and of type FLOAT.	60
SetFloatValue()	F	Sets the value of the specified container leaf element in C or COBOL. The leaf element is of type FLOAT.	60
SetLong()	I	Sets the value of the specified container leaf element in Java. The leaf element is of type LONG.	60
SetLong2()	I	Sets the value of the specified container leaf element in Java. The leaf element is part of an array and of type LONG.	60

Accessor methods	Type	Description	Page
SetLongValue()	I	Sets the value of the specified container leaf element in C or COBOL. The leaf element is of type LONG.	60
SetString()	N	Sets the value of the specified container leaf element in Java. The leaf element is of type STRING.	60
SetString2()	N	Sets the value of the specified container leaf element in Java. The leaf element is part of an array and of type STRING.	60
SetStringValue()	C	Sets the value of the specified container leaf element in C or COBOL. The leaf element is of type STRING.	60
SetValue()	N/F/C/I	Sets the value of the specified container leaf element in C++.	60

Result

A result object represents the result of an API call in C++, C, or COBOL.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
destructor	Destructs the C++ representation of the result object.	75

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. Because a result object represents a supporting object on the client only, the distinction between primary and secondary attributes is not applicable.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
MessageText()	C	Returns the result as a formatted message (in the local language if applicable).	108
ObjectOfCurrentThread()	P	Returns the result object associated with the thread from where this API call is called.	
Origin()	C	Returns the origin of the result, that is, file, line, function.	108
Parameters()	M	Returns the parameters of the result; these are already incorporated in the message text.	109
Rc()	I	Returns the return code remembered in the result object.	107

Service

A service object represents common aspects of MQSeries Workflow service objects.

Note: All API calls of a service object are also applicable to execution services.

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. Because a service object represents a supporting object on the client only, the distinction between primary and secondary attributes is not applicable.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
IsLoggedOn()	B	Indicates whether a user is logged on via this service object.	87
SetTimeout()	I	Sets the time the client will wait for a server to answer. The time is to be specified in milliseconds.	112
SystemGroupName()	C	Returns the name of the system group where the server resides.	108
SystemName()	C	Returns the name of the system where the server resides.	108
Timeout()	I	Returns the time the client will wait for a server to answer.	107
UserID()	C	Returns the user identification of the logged-on user.	108

Refer to "Action API calls" on page 122 for detailed descriptions of action API calls.

Action methods	Description	Page
Refresh()	Refreshes information from the server, especially the logged-on status.	480
SetPassword()	Sets the password of the logged-on user.	481
UserSettings()	Retrieves the user settings of the logged-on user.	483

StringVector

in C or COBOL, a string vector serves to represents a set of string information. For example, a string vector is returned to show the categories the logged-on user is authorized for. Or, a string vector must be used to specify the persons to stand in for.

Refer to "C and COBOL vector accessor functions" on page 21 for detailed descriptions of vector access functions.

Accessor methods	Description
AddElement()	Adds a string to the string vector.

Accessor methods	Description
Allocate()	Allocates the storage for a string vector.
Deallocate()	Deallocates the storage for a string vector.
FirstElement()	Returns the first element of the string vector.
FirstResultParmElement()	Returns the first element of a string vector representing the parameters of a result object; calling this function does not change the result object and thus allows for a consistent read.
NextElement()	Returns the next element of the string vector.
NextResultParmElement()	Returns the next element of a string vector representing the parameters of a result object; calling this function does not change the result object and thus allows for a consistent read.
RemoveElement()	Removes a string from the string vector.
ResultParmDeallocate()	Deallocates the storage for a string vector representing the parameters of a result object; calling this function does not change the result object and thus allows for a consistent read.
ResultParmSize()	Returns the number of elements in a string vector representing the parameters of a result object; calling this function does not change the result object and thus allows for a consistent read.
Size()	Returns the number of elements in the string vector.

SymbolLayout

A symbol layout object represents graphical information of a named icon.

Refer to “Basic API calls” on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs a symbol layout object.	71
Copy()	Allocates and initializes the storage for a symbol layout object by copying.	74
Deallocate()	Deallocates the storage for a symbol layout object.	75
destructor()	Destructs a symbol layout object.	75
Equal()	Compares two symbol layout objects on the basis of their contents.	73
IsEmpty()	Indicates whether symbol layout information is not available.	76
operator=()	Assigns a symbol layout object to this one.	73
operator==()	Compares two symbol layout objects on the basis of their contents.	73

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. All properties are primary properties.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
XPosition()	I	Returns the x-coordinate of the named icon.	107
XPositionOfName()	I	Returns the x-coordinate of the name associated with the icon.	107
YPosition()	I	Returns the y-coordinate of the named icon.	107
YPositionOfName()	I	Returns the y-coordinate of the name associated with the icon.	107

WorkItem

A work item represents an activity instance assigned to a user in order to be worked on.

Note: All API calls of an Item are also applicable to work items.

Refer to "Basic API calls" on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs a work item object.	71
Copy()	Allocates and initializes the storage for a work item object by copying.	74
Deallocate()	Deallocates the storage for a work item object.	75
destructor()	Destructs a work item object.	75
Kind()	In C++, states that the object is a work item.	76
operator=()	Assigns a work item to this one.	73
operator==()	Compares two work items.	73

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls.

Note: The value in the **Set** column shows if this attribute is a primary attribute (P) and set immediately when work items are queried or if this attribute is a secondary attribute (S) and set only after the refresh of a specific work item.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Set/ Type	Description	Page
ActivityKind()	P/E	Returns the kind of the associated activity instance, whether it is a program or process and so on.	88
ErrorReason()	S/O	Returns an error object describing the reason why the associated activity instance is in state InError.	109
ErrorReasonIsNull()	S/B	Indicates whether an error reason is set.	111
ExitCondition()	S/C	Returns the exit condition of the work item.	108
FirstNotificationTime()	S/D	Returns the time the first notification for the work item is to occur or has occurred.	88
FirstNotificationTimeIsNull()	S/B	Indicates whether a first notification time is set.	111
Implementation()	P/C	Returns the name of the implementing program of the associated activity instance.	108
ImplementationIsNull()	P/B	Indicates whether an implementation is set.	111
ManualExitMode()	S/B	Returns whether the exit mode of the work item is manual.	87
ManualStartMode()	S/B	Returns whether the start mode of the work item is manual.	87
Priority()	P/I	Returns the priority of the work item.	107
SecondNotificationTime()	S/D	Returns the time the second notification for the work item is to occur or has occurred.	88
SecondNotificationTimeIsNull()	S/B	Indicates whether a second notification time is set.	111
Staff()	S/M	Returns all persons owning a work item for the associated activity instance.	109
StartCondition()	S/C	Returns the start condition of the work item.	108
State	P/E	Returns the state of the work item.	88
StateOfNotification()	S/E	Returns the notification state of the work item.	88
SupportTools()	P/M	Returns the support tools associated with the work item.	109
SupportToolsIsNull()	P/B	Indicates whether support tools are set.	111

Refer to “Action API calls” on page 122 for detailed descriptions of action API calls.

Action methods	Description	Page
CancelCheckOut()	Cancels the checkout of the work item.	487
CheckIn()	Checks in the work item.	489
CheckOut()	Checks out the work item.	491
Finish()	Finishes a manual exit work item.	495
ForceFinish()	Force finishes the work item.	497
ForceRestart()	Force restarts the work item.	499
InContainer()	Retrieves the input container of the work item.	501
OutContainer()	Retrieves the output container of the work item.	502
PersistentObject()	Retrieves the specified work item.	504
Restart()	Restarts the work item.	506
Start()	Starts the work item.	508
StartTool()	Starts the specified support tool.	509
Terminate()	Terminates the work item.	511

WorkItemVector

A work item vector represents the result of a query for work items in C or COBOL.

Refer to “C and COBOL vector accessor functions” on page 21 for detailed descriptions of vector access functions.

Accessor methods	Description
Deallocate()	Deallocates the storage for a work item vector object.
FirstElement()	Returns the first element of the work item vector.
NextElement()	Returns the next element of the work item vector.
Size()	Returns the number of elements in the work item vector.

Worklist

A worklist represents a group of items.

Note: All API calls of a persistent list are also applicable to worklists.

Refer to “Basic API calls” on page 70 for detailed descriptions of basic API calls.

Basic methods	Description	Page
constructor()	Constructs a worklist object.	71
Copy()	Allocates and initializes the storage for a worklist object by copying.	74
Deallocate()	Deallocates the storage for a worklist object.	75
destructor()	Destructs a worklist object.	75
Equal()	Compares two worklists.	73
operator=()	Assigns a worklist to another one.	73
operator==()	Compares two worklists.	73

Refer to "Accessor API calls" on page 85 for detailed descriptions of accessor API calls. All properties are primary properties.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), a multi-valued property (M), a pointer to some object (P), or an object itself. The API call declaration can be found in a general format at the indicated page.

Accessor methods	Type	Description	Page
BeepOption()	B	Indicates whether a beep should sound when the contents of the worklist changes.	87

Refer to "Action API calls" on page 122 for detailed descriptions of action API calls.

Action methods	Description	Page
QueryActivityInstance Notifications()	Retrieves the activity instance notifications qualifying via the worklist.	514
QueryItems()	Retrieves all items qualifying via the worklist.	517
QueryProcessInstanceNotifications()	Retrieves the process instance notifications qualifying via the worklist.	519
QueryWorkitems()	Retrieves the work items qualifying via the worklist.	521

WorklistVector

A worklist vector represents the result of a query for worklists in C or COBOL.

Refer to "C and COBOL vector accessor functions" on page 21 for detailed descriptions of vector access functions.

The value in the **Type** column states the type of the property returned, whether it is a boolean (B), a character string (C), a date/time value (D), an enumeration (E), an integer (I), or a multi-valued property (M), a pointer to some object (P), or an object itself (O). The API call declaration can be found in a general format at the indicated page.

Accessor methods	Description
Deallocate()	Deallocates a worklist vector object.
FirstElement()	Returns the first element of the worklist vector.
NextElement()	Returns the next element of the worklist vector.
Size()	Returns the number of elements in the worklist vector.

Chapter 5. API action and activity implementation calls

The following chapter describes the MQSeries Workflow action and activity implementation API calls in alphabetical order by class.

Each entry contains a functional description of the API call followed by subsections:

Usage notes Points to general information about the nature of this call.
Authorization States the authority required to have the API call executed.
Required connection
States the MQSeries Workflow server a session must have been established with.
API interface declarations
Shows the required file declarations and calling sequences.
Parameters Describes each of the parameters together with an indication of whether the parameter is an input or output parameter.
Return type Describes the type of value returned by the call.
Return codes/ FmcException
Lists all possible return codes or exceptions which may issued or raised by this call.
Examples Points to an example of the call.

ActivityInstance actions

An ActivityInstance object represents an instance of an activity of a process instance. An activity instance is uniquely identified by its object identifier or by its fully qualified name within the process instance. The fully qualified name of an activity instance is a name in dot notation where the hierarchy of nested activities of type *Block* is presented from left to right, and their names are separated by a dot.

The following sections describe the actions which can be applied on an activity instance. See "ActivityInstance" on page 229 for a complete list of API calls.

ObtainProcessInstanceMonitor()

This API call retrieves the process instance monitor for the process instance the activity instance is part of from the MQSeries Workflow execution server (action call).

When the deep option is specified, all activity instances of type Block are resolved, that is, their block instance monitors are also fetched from the server.

Note: Deep is not yet supported.

In C++, when the process instance monitor object to be initialized is not empty, that object is destructed before the new one is assigned. In C, the application is completely responsible for the ownership of objects, that is, it is not checked whether the process instance monitor handle already points to some object.

Usage notes

- See "Action API calls" on page 122 for general information.

ActivityInstance

Authorization

One of:

- Process authorization
- Process administration authorization
- Be the process administrator
- Be the process creator
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ActivityInstance
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjActivityInstanceObtainProcessInstanceMonitor(
       FmcjActivityInstanceHandle            hdlInstance,
       bool                                  deep,
       FmcjProcessInstanceMonitorHandle *    monitor)
```

C++

```
APIRET ObtainProcessInstanceMonitor(
       FmcjProcessInstanceMonitor &          monitor,
       bool                                  deep= false ) const
```

Java

```
public abstract
ProcessInstanceMonitor obtainProcessInstanceMonitor( boolean deep )
throws FmcException
```

COBOL

```
        FmcjAINObtainProcInstMon.
           CALL    "FmcjItemObtainProcessInstanceMonitor"
                          USING
                          BY VALUE
                             hdlItem
                             deep
                          BY REFERENCE
                             monitor
                 RETURNING
                             intReturnValue.
```

Parameters

deep Input. An indicator whether activity instances of type Block are to be resolved, that is, their monitor is also to be provided. Note: deep is not yet supported.

hdlInstance Input. The activity instance whose process instance monitor is to be retrieved.

monitor Input/Output. The address of the handle to the process instance monitor or the process instance monitor object to be set.

returnCode Input/Output. The result of calling this method - see return codes below.

Return type

APIRET The result of calling this method - see return codes below.

InstanceMonitor*/ProcessInstanceMonitor*/ ProcessInstanceMonitor
A pointer to the process instance monitor or the process instance monitor.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The activity instance no longer exists.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

SubProcessInstance()

This API call retrieves the process instance which implements the activity instance from the MQSeries Workflow execution server (action call).

All information about the process instance, primary and secondary, is retrieved.

In C++, when the process instance object to be initialized is not empty, then that object is destructed before the new one is assigned. In C, the application is completely responsible for the ownership of objects, that is, no check is made whether the process instance handle already points to an object.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Process authorization
- Process administration authorization
- Be the process creator
- Be the process administrator
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ActivityInstance
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjActivityInstanceSubProcessInstance(
       FmcjActivityInstanceHandle   hdlInstance,
       FmcjProcessInstanceHandle *  instance )
```

C++

```
APIRET SubProcessInstance( FmcjProcessInstance & instance ) const
```

Java

```
public abstract
ProcessInstance subProcessInstance() throws FmcException
```

COBOL

```
         FmcjAISubProcInst.

            CALL    "FmcjActivityInstanceSubProcessInstance"
                           USING
                           BY VALUE
                              hdlInstance
                           BY REFERENCE
                              instance
                           RETURNING
                              intReturnValue.
```

Parameters

hdlInstance Input. The handle of the activity instance object to be queried.
instance Input/Output. The subprocess instance object to be retrieved (initialized).
returnCode Input/Output. The result of calling this method - see return codes below.

Return type
APIRET
The result of calling this method - see return codes below.
ProcessInstance*/ ProcessInstance
A pointer to the subprocess instance or the subprocess instance.

Return codes/ FmcException
FMC_OK(0) The API call completed successfully.
FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.
FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.
FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_DOES_NOT_EXIST(118)
The activity instance no longer exists.
FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

ActivityInstanceNotification actions

An ActivityInstanceNotification object represents a notification on an activity instance assigned to a user.

Other items assigned to users are process instance notifications and work items. FmcjItem or Item represents the common properties of all items.

In C++, FmcjActivityInstanceNotification is thus a subclass of the FmcjItem class and inherits all properties and methods. In Java, ActivityInstanceNotification is thus a subclass of the Item class and inherits all properties and methods. Similarly, in C or COBOL, common implementations of functions are taken from FmcjItem. That is, common functions start with the prefix FmcjItem; they are also defined starting with the prefix FmcjActivityInstanceNotification.

An activity instance notification is uniquely identified by its object identifier.

The following sections describe the actions which can be applied on an activity instance notification. See "ActivityInstanceNotification" on page 233 for a complete list of API calls.

PersistentObject()

This API call retrieves the activity instance notification identified by the passed object identifier from the MQSeries Workflow execution server (action call).

The MQSeries Workflow execution server from which the activity instance notification is to be retrieved is identified by the execution service object. The transient object is then created or updated with all information (primary and secondary) of the activity instance notification.

In C++, when the activity instance notification object to be initialized is not empty, that object is destructed before the new one is assigned. In C or COBOL, the application is completely responsible for the ownership of objects, that is, no check is made whether the activity instance notification handle already points to some object. In Java, an activity instance notification is newly created; the execution service acts as a factory.

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

One of:

- Be the item owner
- Work item authorization
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjActivityInstanceNotificationPersistentObject(
       FmcjExecutionServiceHandle                    service,
       char const *                                  oid,
       FmcjActivityInstanceNotificationHandle *      hdlItem )
```

C++

```
APIRET PersistentObject( FmcjExecutionService const & service,
                         string const &               oid )
```

Java

```
public abstract
  ActivityInstanceNotification
  ExecutionService.persistentActivityInstanceNotification( String oid )
throws FmcException
```

COBOL

```
        FmcjAINPersistentObj.

           CALL    "FmcjActivityInstanceNotificationPersistentObject"
                          USING
                          BY VALUE
                             serviceValue
                             oid
                          BY REFERENCE
                             hdlItem
                          RETURNING
                             intReturnValue.
```

Parameters

hdlItem Input/Output. The address of the handle to the activity instance notification object to be set.

oid Input. The object identifier of the activity instance notification to be retrieved.

service Input. The service object representing the session with the execution server.

Return type

ActivityInstanceNotification
The activity instance notification retrieved.

long/ APIRET The return code of calling this method - see below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The activity instance notification no longer exists.

FMC_ERROR_INVALID_OID(805)
The provided oid is invalid.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

StartTool()

This API call starts the specified support tool (action call) for a user in a LAN environment.

The support tool must be one of the tools associated with the activity instance the notification has been created for. It is then started via the program execution agent associated with the logged-on user.

Note: A support tool can be started only via a program execution agent in the LAN environment; starting via a program execution server (in either environment) is currently not supported. Since there are only unattended processes under MQSeries Workflow for OS/390, it is not meaningful to start a support tool in this environment. The PES will simply ignore such an attempt.

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

Be the activity instance notification owner

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ActivityInstanceNotification
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjActivityInstanceNotificationStartTool(
                    FmcjActivityInstanceNotificationHandle hdlItem,
                    char const *                           toolName )
```

C++

```
APIRET StartTool( string const & toolName ) const
```

Java

```
public abstract
void   startTool( String toolName ) throws FmcException
```

COBOL

```
        FmcjAINStartTool.

           CALL    "FmcjActivityInstanceNotificationStartTool"
                          USING
                          BY VALUE
                             hdlItem
                             toolName
                          RETURNING
                             intReturnValue.
```

Parameters

hdlItem Input. The handle of the activity instance notification to be dealt with.

toolName Input. The support tool to be started.

Return type

long/ APIRET The return code of calling this method - see below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The work item no longer exists.

FMC_ERROR_INVALID_TOOL(129)
No tool name is provided or the specified tool is not defined for the activity instance notification.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

BlockInstanceMonitor actions

A BlockInstanceMonitor object represents a monitor for an activity instance of type *Block*.

Note: The ownership of a block instance monitor stays with the embracing process instance monitor. A block instance monitor is automatically deleted when the process instance monitor is deleted. After that action, using the block instance monitor handle or object is invalid.

An FmcjBlockInstanceMonitor or a BlockInstanceMonitor object represents the common aspects of monitors. In C++, FmcjBlockInstanceMonitor is thus the superclass of the FmcjProcessInstanceMonitor class and provides for all common properties and methods. In Java, BlockInstanceMonitor is thus a superclass of the ProcessInstanceMonitor class and provides for all common properties and methods. Similarly, in C or COBOL, common implementations of functions are taken from FmcjBlockInstanceMonitor. That is, common functions start with the prefix FmcjBlockInstanceMonitor; they are also defined starting with the prefix FmcjProcessInstanceMonitor.

The following sections describe the actions which can be applied on a block instance monitor. See "BlockInstanceMonitor" on page 237 for a complete list of API calls.

ObtainBlockInstanceMonitor()

This API call retrieves the block instance monitor for the specified activity instance from the MQSeries Workflow execution server (action call). If the block instance monitor has already been retrieved, then that monitor is returned to the caller.

The specified activity instance must be of type *Block* and be part of this block instance monitor.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Process authorization
- Process administration authorization
- Be the process administrator
- Be the process creator
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C fmcjcrun.h

C++ fmcjprun.hxx

Java com.ibm.workflow.api.BlockInstanceMonitor

COBOL fmcvars.cpy, fmcperf.cpy

C

```
FmcjBlockInstanceMonitorHandle
    FMC_APIENTRY FmcjBlockInstanceMonitorObtainBlockInstanceMonitor(
       FmcjBlockInstanceMonitorHandle  hdlMonitor,
       FmcjActivityInstanceHandle      activity )
```

C++

```
FmcjBlockInstanceMonitor *
ObtainBlockInstanceMonitor( FmcjActivityInstance const & activity ) const

APIRET
ObtainBlockInstanceMonitor( FmcjActivityInstance const & activity,
                            FmcjBlockInstanceMonitor &   monitor ) const
```

Java

```
public abstract
    BlockInstanceMonitor obtainBlockInstanceMonitor(
       ActivityInstance activity ) throws FmcException
```

COBOL

```
        FmcjBIMObtainBlockInstMon.

           CALL
                  "FmcjBlockInstanceMonitorObtainBlockInstanceMonitor"
                          USING
                          BY VALUE
                             hdlMonitor
                             activity
                          RETURNING
                             FmcjBIMHandleReturnValue.
```

Parameters

activity Input. The activity instance of type Block whose block instance monitor is to be retrieved.

hdlMonitor Input. The block instance monitor containing the activity instance of type Block.

monitor Input/Output. The block instance monitor retrieved.

Return type

APIRET The result returned by this API call - see return codes below.

FmcjBlockInstanceMonitor*/ Handle/ BlockInstanceMonitor
The block instance monitor or a pointer or handle to the block instance monitor.

APIRET or the MQSeries Workflow **result object** can return the following codes or the following FmcExceptions can be thrown:

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The specified activity instance is not described by the block instance monitor.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_WRONG_KIND(501)
The specified activity instance is not of type Block.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

ObtainProcessInstanceMonitor()

This API call retrieves the process instance monitor for the specified activity instance from the MQSeries Workflow execution server (action call). If the process instance monitor has already been retrieved, then that monitor is returned to the caller.

The specified activity instance must be of type *Process* and be part of this block instance monitor.

When the *deep* option is specified, then activity instances of type Block are resolved, that is, their block instance monitors are also fetched from the server.

Note: Deep is not yet supported.

Usage notes

- See “Action API calls” on page 122 for general information.

Authorization

One of:

- Process authorization
- Process administration authorization
- Be the process administrator

- Be the process creator
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.BlockInstanceMonitor
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
FmcjProcessInstanceMonitorHandle
    FMC_APIENTRY FmcjBlockInstanceMonitorObtainProcessInstanceMonitor(
        FmcjBlockInstanceMonitorHandle  hdlMonitor,
        FmcjActivityInstanceHandle      activity,
        bool                            deep      )
```

C++

```
FmcjProcessInstanceMonitor *
    ObtainProcessInstanceMonitor(
       FmcjActivityInstance const &     activity,
       bool                             deep= false ) const

APIRET ObtainProcessInstanceMonitor(
       FmcjActivityInstance const &     activity,
       FmcjProcessInstanceMonitor &     monitor,
       bool                             deep= false   ) const
```

Java

```
public abstract
  ProcessInstanceMonitor
  obtainProcessBlockInstanceMonitor( ActivityInstance activity,
                                     boolean          deep    )
throws FmcException
```

COBOL

```
FmcjBIMObtainProcInstMon.

   CALL
        "FmcjBlockInstanceMonitorObtainProcessInstanceMonitor"
                  USING
                  BY VALUE
                     hdlMonitor
                     activity
                     deep
                  RETURNING
                     FmcjPIMHandleReturnValue.
```

Parameters

activity Input. The activity instance of type Process whose process instance monitor is to be retrieved.

deep Input. An indicator whether activity instances of type Block are to be resolved, that is, their monitor is also to be provided. Note, deep is not yet supported.

hdlMonitor Input. The block instance monitor containing the activity instance of type Process.

monitor Output. The process instance monitor retrieved.

Return type

APIRET The result returned by this API call - see return codes below.

FmcjProcessInstanceMonitor*/ Handle/ ProcessInstanceMonitor
The process instance monitor or a pointer or handle to the process instance monitor.

APIRET or the MQSeries Workflow **result object** can return the following codes or the following FmcExceptions can be thrown:

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The specified activity instance is not described by the block instance monitor.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_WRONG_KIND(501)
The specified activity instance is not of type Process.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Refresh()

This API call refreshes the block instance monitor from the MQSeries Workflow execution server (action call).

All information about the block instance monitor is retrieved.

When the deep option is specified, then activity instances of type Block are resolved, that is, their block instance monitors are also refreshed from the server.

Note: Deep is not yet supported.

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

One of:

- Process authorization
- Process administration authorization
- Be the process administrator
- Be the process creator
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.BlockInstanceMonitor
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjBlockInstanceMonitorRefresh(
       FmcjBlockInstanceMonitorHandle hdlMonitor,
       bool                           deep      )
```

C++

```
APIRET Refresh( bool deep= false )
```

Java

```
public abstract
void   refresh( boolean deep ) throws FmcException
```

COBOL

```
         FmcjBIMRefresh.

            CALL    "FmcjBlockInstanceMonitorRefresh"
                           USING
                           BY VALUE
                              hdlMonitor
                              deep
                           RETURNING
                              intReturnValue.
```

Parameters

deep Input. An indicator whether activity instances of type Block are to be resolved, that is, their monitor is also to be provided. Note, deep is not yet supported.

hdlMonitor Input. The handle of the block instance monitor to be refreshed.

Return type

APIRET The result returned by this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1) A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122) The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130) The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118) The process instance no longer exists.

FMC_ERROR_NOT_AUTHORIZED(119) Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106) Not logged on.

FMC_ERROR_COMMUNICATION(13) The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100) An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103) An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14) Timeout has occurred.

Container activity implementation calls

A Container object represents a data container of a process template, process instance, work item, or activity implementation . A container can be a read-only input container or a read/write input or output container.

The API calls defined for the container allow to access the values of data members of a basic type (container leaves), or to get a substructure of a container, a container element.

A Container object represents the common aspects of read-only or read/write containers. In C++, FmcjContainer is thus the superclass of the FmcjReadOnlyContainer and FmcjReadWriteContainer classes and provides for all common properties and methods. In Java, Container is thus a superclass of the ReadOnlyContainer and ReadWriteContainer classes and provides for all common properties and methods. Similarly, in C or COBOL, common implementations of functions are taken from FmcjContainer. That is, common functions start with the prefix FmcjContainer; they are also defined starting with the prefixes FmcjReadOnlyContainer and FmcjReadWriteContainer.

The following sections describe the activity implementation functions which are used for communication between an activity implementation and a program execution server. See “Container” on page 238 for a complete list of API calls on containers.

InContainer()

This API call retrieves the input container from the CICS COMMAREA or IMS I/O Area (activity implementation call).

It can be used only from within an activity implementation.

Note: This call will fail if the COMMAREA or I/O Area has been changed with SetOutContainer() or SetRemoteOutContainer().

Usage notes

- See “Activity implementation API calls” on page 122 for general information.

Authorization

Be an activity implementation.

Required connection

None, but MQSeries Workflow program execution server must be active.

API interface declarations

C	fmcjccon.h or fmcjcrun.h
C++	fmcjpcon.hxx or fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionAgent
COBOL	fmcvars.cpy, fmcperf.cpy (or fmcperfl.cpy)

C

```
APIRET  FMC_APIENTRY FmcjContainerInContainer(
        FmcjReadOnlyContainerHandle * input )
```

C++

```
static APIRET InContainer( FmcjReadOnlyContainer & input )
```

Java

```
public abstract
       ReadOnlyContainer ExecutionAgent.inContainer()
throws FmcException
```

COBOL

```
         FmcjCInCtnr.

            CALL    "FmcjContainerInContainer"
                           USING
                           BY REFERENCE
                              inputValue
                           RETURNING
                              intReturnValue.
```

Parameters

input Input/Output. The address of the input container handle or the input container of the activity implementation to be set.

Return type

long/ APIRET

The return code from this API call - see return codes below.

ReadOnlyContainer

The input container of the activity implementation.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)

A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)

The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)

The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_NO_CTNR_ACCESS(1021)

The program does not have an input container.

FMC_ERROR_NOT_AUTHORIZED(119)

Not authorized to use the API call.

FMC_ERROR_PROGRAM_EXECUTION(126)
The API call was not issued from within an activity implementation or the program execution server is not active.
FMC_ERROR_COMMUNICATION(13)
The specified program execution server cannot be reached.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

Examples
- For a C example, see "Programming an activity implementation (C)" on page 573
- For a C++ example, see "Programming an activity implementation (C++)" on page 574
- For a COBOL example, see "Programming an activity implementation (COBOL)" on page 575

OutContainer()

This API call retrieves the output container from the CICS COMMAREA or IMS I/O Area (activity implementation call).

It can be used only from within an activity implementation.

Note: This call will fail if the COMMAREA or I/O Area has been changed with SetOutContainer() or SetRemoteOutContainer().

Usage notes
- See "Activity implementation API calls" on page 122 for general information.

Authorization

Be an activity implementation.

Required connection

None, but MQSeries Workflow program execution server must be active.

API interface declarations

C	fmcjccon.h or fmcjcrun.h
C++	fmcjpcon.hxx or fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionAgent
COBOL	fmcvars.cpy, fmcperf.cpy (or fmcperfl.cpy)

C

```
APIRET  FMC_APIENTRY FmcjContainerOutContainer(
        FmcjReadWriteContainerHandle * output )
```

C++

```
static APIRET OutContainer( FmcjReadWriteContainer & output )
```

Java

```
public abstract
       ReadWriteContainer ExecutionAgent.outContainer()
throws FmcException
```

COBOL

```
         FmcjCOutCtnr.

            CALL    "FmcjContainerOutContainer"
                           USING
                           BY REFERENCE
                              outputValue
                           RETURNING
                              intReturnValue.
```

Parameters

output Input/Output. The address of the output container handle or the output container of the activity implementation to be set.

Return type

long/ APIRET The return code from this API call - see return codes below.

ReadWriteContainer

The output container of the activity implementation.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)

A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)

The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)

The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_NO_CTNR_ACCESS(1021)

The program does not have an output container.

FMC_ERROR_NOT_AUTHORIZED(119)

Not authorized to use the API call.

FMC_ERROR_PROGRAM_EXECUTION(126)

The API call was not issued from within an activity implementation, or the program execution server is not active.

FMC_ERROR_COMMUNICATION(13)

The specified program execution server cannot be reached.

FMC_ERROR_INTERNAL(100)

An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)

An internal message format error. Contact your IBM representative.

Examples

- For a C example, see "Programming an activity implementation (C)" on page 573

- For a C++ example, see "Programming an activity implementation (C++)" on page 574
- For a COBOL example, see "Programming an activity implementation (COBOL)" on page 575

RemoteInContainer()

This API call retrieves the input container from the CICS COMMAREA or IMS I/O Area (activity implementation call).

It can be used only from within a program started by an activity implementation, if the COMMAREA or I/O Area was passed to the program.

Note: This call will fail if the COMMAREA or I/O Area has been changed with SetOutContainer() or SetRemoteOutContainer().

Usage notes

- See "Activity implementation API calls" on page 122 for general information.

Authorization

Be a program started by an activity implementation.

Required connection

None, but MQSeries Workflow program execution server must be active.

API interface declarations

C	fmcjccon.h or fmcjcrun.h
C++	fmcjpcon.hxx or fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionAgent
COBOL	fmcvars.cpy, fmcperf.cpy (or fmcperfl.cpy)

C

```
APIRET  FMC_APIENTRY FmcjContainerRemoteInContainer(
        char const *                 programID,
        FmcjReadOnlyContainerHandle * input )
```

C++

```
static APIRET RemoteInContainer(
       string const &               programID,
       FmcjReadOnlyContainer &      input )
```

Java

```
public abstract
   ReadOnlyContainer ExecutionAgent.remoteInContainer( String programID )
throws FmcException
```

COBOL

```
FmcjCRemoteInCtnr.

   CALL    "FmcjContainerRemoteInContainer"
                  USING
                  BY REFERENCE
                     programID
                     inputValue
                  RETURNING
                     intReturnValue.
```

Parameters

input Input/Output. The address of the input container handle or the input container of the activity implementation to be set.

programID Input. The program identification by which the activity implementation is known to the program execution server.

Return type

long/ APIRET The return code from this API call - see return codes below.

ReadOnlyContainer

The input container of the activity implementation>.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)

A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)

The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)

The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_INVALID_PROGRAMID(135)

The program identification is invalid.

FMC_ERROR_NO_CTNR_ACCESS(1021)

The program does not have an input container.

FMC_ERROR_NOT_AUTHORIZED(119)

Not authorized to use the API call.

FMC_ERROR_PROGRAM_EXECUTION(126)

The API call was not issued from within an activity implementation, or the program execution server is not active.

FMC_ERROR_COMMUNICATION(13)

The specified program execution server cannot be reached.

FMC_ERROR_INTERNAL(100)

An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)

An internal message format error. Contact your IBM representative.

RemoteOutContainer()

This API call retrieves the output container from the CICS COMMAREA or IMS I/O Area (activity implementation call).

It can be used only from within a program started by an activity implementation if the COMMAREA or I/O Area was passed to the program.

Note: This call will fail if the COMMAREA or I/O Area has been changed with SetOutContainer() or SetRemoteOutContainer().

Usage notes

- See "Activity implementation API calls" on page 122 for general information.

Authorization

Be a program started by an activity implementation.

Required connection

None, but MQSeries Workflow program execution server must be active.

API interface declarations

C	fmcjccon.h or fmcjcrun.h
C++	fmcjpcon.hxx or fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionAgent
COBOL	fmcvars.cpy, fmcperf.cpy (or fmcperfl.cpy)

C

```
APIRET  FMC_APIENTRY FmcjContainerRemoteOutContainer(
        char const *                  programID,
        FmcjReadWriteContainerHandle * output )
```

C++

```
static APIRET RemoteOutContainer(
       string const &                 programID,
       FmcjReadWriteContainer &       output )
```

Java

```
public abstract
   ReadWriteContainer ExecutionAgent.remoteOutContainer( String programID )
throws FmcException
```

COBOL

```
FmcjCRemoteOutCtnr.

   CALL    "FmcjContainerRemoteOutContainer"
                  USING
                  BY REFERENCE
                     programID
                     outputValue
                  RETURNING
                     intReturnValue.
```

Parameters

output Input/Output. The address of the output container handle or the output container of the activity implementation to be set.

programID Input. The program identification by which the activity implementation is known to the program execution server.

Return type

long/ APIRET The return code from this API call - see return codes below.

ReadWriteContainer
The output container of the activity implementation.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_INVALID_PROGRAMID(135)
The program identification is invalid.

FMC_ERROR_NO_CTNR_ACCESS(1021)
The program does not have an output container.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_PROGRAM_EXECUTION(126)
The API call was not issued from within an activity implementation, or the program execution server is not active.

FMC_ERROR_COMMUNICATION(13)
The specified program execution server cannot be reached.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

SetOutContainer()

This API call returns the output container to the MQSeries Workflow program execution server (activity implementation call).

It can be used from within an activity implementation as often as required. Note, however, that the output container is not returned to the MQSeries Workflow execution server until the activity implementation ends. It is kept transiently in the CICS COMMAREA or IMS I/O Area.

Note: The calls InContainer(), OutContainer(), ServicePassthrough(), and their "remote" counterparts will fail after this function is called, due to an altered COMMAREA or I/O Area.

Usage notes

- See "Activity implementation API calls" on page 122 for general information.

Authorization

Be an activity implementation.

Required connection

None, but MQSeries Workflow program execution server must be active.

API interface declarations

C	fmcjccon.h or fmcjcrun.h
C++	fmcjpcon.hxx or fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionAgent
COBOL	fmcvars.cpy, fmcperf.cpy (or fmcperfl.cpy)

C

```
APIRET  FMC_APIENTRY FmcjContainerSetOutContainer(
        FmcjReadWriteContainerHandle const output )
```

C++

```
static APIRET SetOutContainer( FmcjReadWriteContainer const & output )
```

Java

```
public abstract
  void ExecutionAgent.setOutContainer( ReadWriteContainer output )
throws FmcException
```

COBOL

```
         FmcjCSetOutCtnr.

            CALL    "FmcjContainerSetOutContainer"
                           USING
                           BY VALUE
                              outputValue
                           RETURNING
                              intReturnValue.
```

Parameters

output Input. The output container handle or the output container of the activity implementation to be passed.

Return type

long/ APIRET The return code from this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_NO_CTNR_ACCESS(1021)
The program does not have an output container.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_PROGRAM_EXECUTION(126)
The API call was not issued from within an activity implementation, or the program execution server is not active.

FMC_ERROR_COMMUNICATION(13)
The specified program execution server cannot be reached.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

Examples

- For a C example, see "Programming an activity implementation (C)" on page 573
- For a C++ example, see "Programming an activity implementation (C++)" on page 574

SetRemoteOutContainer()

This API call returns the output container to the MQSeries Workflow program execution server (activity implementation call).

It can be used from within a program started by an activity implementation as often as required. Note, however, that the output container is not returned to the MQSeries Workflow execution server until the activity implementation ends. It is kept transiently in the CICS COMMAREA or IMS I/O Area.

Note: The calls InContainer(), OutContainer(), ServicePassthrough(), and their "remote" counterparts will fail after this function is called, due to an altered COMMAREA or I/O Area.

Usage notes

- See "Activity implementation API calls" on page 122 for general information.

Authorization

Be a program started bz an activity implementation.

Required connection

None, but MQSeries Workflow program execution server must be active.

API interface declarations

C	fmcjccon.h or fmcjcrun.h
C++	fmcjpcon.hxx or fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionAgent
COBOL	fmcvars.cpy, fmcperf.cpy (or fmcperfl.cpy)

C

```
APIRET  FMC_APIENTRY FmcjContainerSetRemoteOutContainer(
        char const *                        programID,
        FmcjReadWriteContainerHandle const output )
```

C++

```
static APIRET SetRemoteOutContainer(
       string const &                   programID,
       FmcjReadWriteContainer const &   output )
```

Java

```
public abstract
void   ExecutionAgent.setRemoteOutContainer( String             programID,
                                             ReadWriteContainer output   )
throws FmcException
```

COBOL

```
         FmcjCSetRemoteOutCtnr.

            CALL    "FmcjContainerSetRemoteOutContainer"
                           USING
                           BY REFERENCE
                              programID
                           BY VALUE
                              outputValue
                           RETURNING
                              intReturnValue.
```

Parameters

output	Input. The output container handle or the output container of the activity implementation to be passed.
programID	Input. The program identification by which the activity implementation is known to the program execution server.

Return type

long/ APIRET	The return code from this API call - see return codes below.

Container

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_INVALID_PROGRAMID(135)
The program identification is invalid.

FMC_ERROR_NO_CTNR_ACCESS(1021)
The program does not have an output container.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_PROGRAM_EXECUTION(126)
The API call was not issued from within an activity implementation, or the program execution server is not active.

FMC_ERROR_COMMUNICATION(13)
The specified program execution server cannot be reached.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

ExecutionService actions

An ExecutionService object represents a session between a user and an MQSeries Workflow execution server so that Runtime services may be requested.

The execution service object essentially provides for the basic API calls to set up a communication path to the specified MQSeries Workflow execution server and to establish the user session (log on), and finish it (log off).

At FmcjExecutionService or ExecutionService construction or allocation time the name of the MQSeries Workflow system and system group where the execution server resides can be specified. Default values are taken from the current user's profile or from the configuration profile, in this sequence, when logging on. The configuration where to search for the profiles can also be specified.

When the session to an execution server has been established, you can query objects for which you are authorized; for example, you can query process templates, process instances, or work items. The attributes of the queried objects can then be read and further actions can be requested. For example, once a process template has been queried, creation of a process instance can be asked for.

When the execution service object is destructed or deallocated and still represents an active session, logoff is automatically called (provided that there is no other object referencing this session). It is, however, recommended that logon and logoff calls are paired before the execution service object is deallocated.

FmcjService or Service represents common properties of services.

In C++, FmcjExecutionService is thus a subclass of the FmcjService class and inherits all properties and methods. In the Java language, ExecutionService is thus a subclass of the Service class and inherits all properties and methods. Similarly, in C and COBOL, common implementations of functions are taken from FmcjService. That is, common functions start with the prefix FmcjService; they are also defined starting with the prefix FmcjExecutionService.

The following sections describe the actions which can be applied on an execution service. See "ExecutionService" on page 248 for a complete list of API calls.

CreateProcessInstanceList()

This API call creates a process instance list on the MQSeries Workflow execution server so that process instances can be grouped to one's own taste or for a group of users (action call).

A process instance list is identified by:
- Its name, which is unique per type
- Its type, that is, an indicator whether the list is for public or private usage
- Its owner, that is, the owner of the list when the type is private

If the list is for public usage, any owner specification is ignored. If the list is for private usage and no owner is provided, then the list is created for the logged-on user.

When the process instance list is to be created for public usage or for the private usage of another user, that is, not the logged-on user itself, then the logged-on user needs to have staff definition authorization.

A process instance list groups a set of process instances which have the same characteristics. These characteristics are defined via search filters. The number of process instances in the list can be restricted via a threshold which specifies the maximum number of process instances to be returned to the client. That threshold is applied after the process instance list has been sorted according to sort criteria specified. Note that process instances are sorted on the server, that is, the code page of the server determines the sort sequence.

The following rules apply for specifying a process instance list name:
- You can specify a maximum of 32 characters.
- You can use any printable characters depending on your current locale, except the following:

  `* ? " ; : .`
- You can use blanks with these restrictions: no leading blanks, no trailing blanks, and no consecutive blanks.

The following rules apply for specifying a description:
- You can specify a maximum of 254 characters.
- You can use any printable characters depending on your current locale, including the end-of-line and new-line characters.

A process instance list filter is specified as a character string containing a filter on process instances (refer to "How to read the syntax diagrams" on page xii).

Notes:

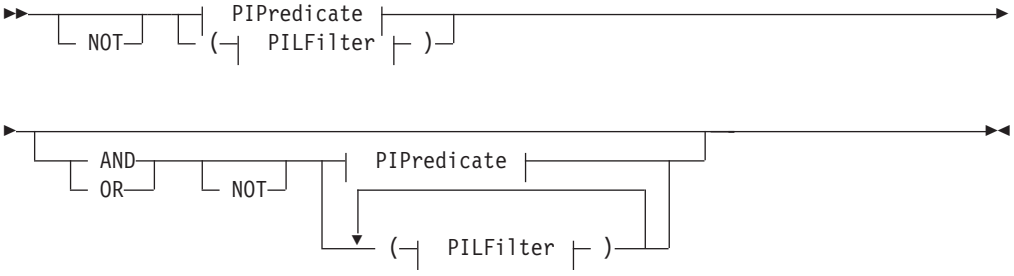
1. A *string* constant is to be enclosed in single quotes (').

A *pattern* is a string constant in which the asterisk and the question mark have special meanings.

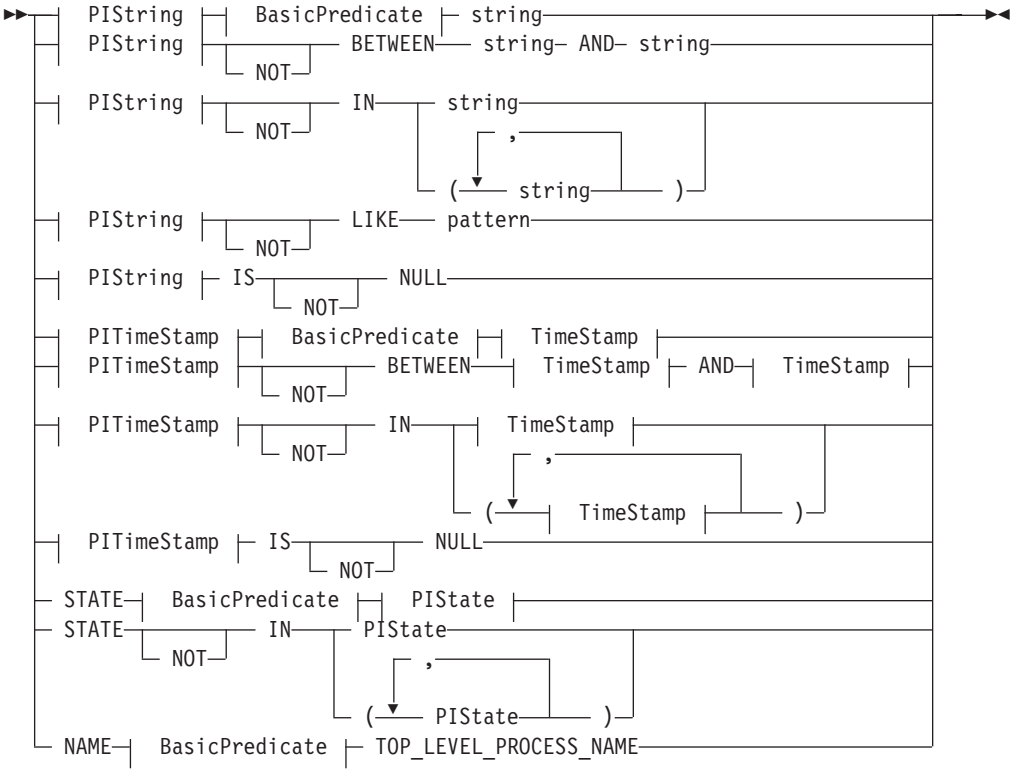
- The question mark (?) represents any single character.
- The asterisk (*) represents a string of zero or more characters.
- The escape character is backslash (\) and must be used when the pattern itself contains actual question marks or asterisks.

2. Optional specifications in the *TimeStamp* are set to 0 (zero) if not specified.

PILFilter



PIPredicate



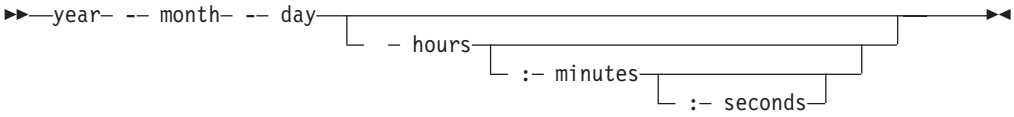
BasicPredicate

PIState

PIString

PITimeStamp

TimeStamp

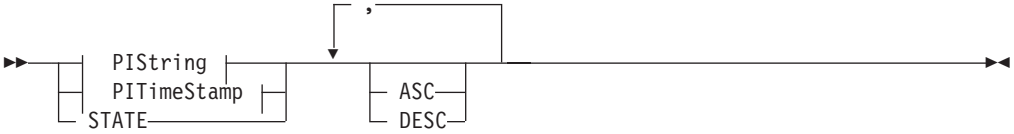


A process instance list sort criterion is specified as a character string.

Note: The default sort order is ascending.

States are sorted according to the sequence shown in the PIState diagram.

PILOrderBy



Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

None or staff definition or be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjExecutionServiceCreateProcessInstanceList(
       FmcjExecutionServiceHandle         service,
       char const *                       name,
       enum FmcjPersistentListTypeOfList  type,
       char const *                       owner,
       char const *                       description,
       char const *                       filter,
       char const *                       sortCriteria,
       unsigned long *                    threshold,
       FmcjProcessInstanceListHandle *    newList )
```

C++

```
APIRET CreateProcessInstanceList(
       string const &                  name,
       FmcjPersistentList::TypeOfList  type,
       string const *                  owner,
       string const *                  description,
       string const *                  filter,
       string const *                  sortCriteria,
       unsigned long const *           threshold,
       FmcjProcessInstanceList &       newList ) const
```

Java

```
public abstract
ProcessInstanceList createProcessInstanceList(
       String                          name,
       TypeOfList                      type,
       String                          owner,
       String                          description,
       String                          filter,
       String                          sortCriteria,
       Integer                         threshold   ) throws FmcException
```

COBOL

```
        FmcjESCreateProcInstList.

           CALL    "FmcjExecutionServiceCreateProcessInstanceList"
                          USING
                          BY VALUE
                             serviceValue
                             name
                             typeValue
                             ownerValue
                             description
                             filter
                             sortCriteria
                             threshold
                          BY REFERENCE
                             newList
                          RETURNING
                             intReturnValue.
```

Parameters

description Input. A user-defined description of the process instance list.

filter Input. The filter criteria which characterize the process instances to be contained in the process instance list.

name Input. A user-defined name for the process instance list.

newList Input/Output. The newly created process instance list.

owner Input. The owner of the list when the type is private. Ignored for public lists.

service Input. A handle to the service object representing the session with the execution server.

sortCriteria Input. The sort criteria to be applied to the process instances in the process instance list.

threshold Input. The threshold which defines the maximum number of process instances in the process instance list to be passed to the client.

type Input. An indication whether a private or a public list is to be created.

Return type

long/ APIRET The return code from this API call - see return codes below.

ProcessInstanceList

The newly created process instance list.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_INVALID_DESCRIPTION(810)
The specified description is invalid.

FMC_ERROR_INVALID_FILTER(125)
The specified filter is invalid.

FMC_ERROR_INVALID_LIST_TYPE(813)
The specified list type is invalid.

FMC_ERROR_INVALID_NAME(134)
The specified process instance list name does not comply with the syntax rules.

FMC_ERROR_INVALID_USER(132)
The user ID specified for the owner of the list does not conform to the syntax rules.

FMC_ERROR_INVALID_SORT(808)
The specified sort criteria are invalid.

FMC_ERROR_INVALID_THRESHOLD(807)
The specified threshold is invalid; exceeds the maximum possible value.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized.

FMC_ERROR_OWNER_NOT_FOUND(812)
The person to become the owner of the process instance list is not found.

FMC_ERROR_NOT_UNIQUE(121)
The name of the process instance list is not unique within the specified type.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples

- For a C example, see “Create a process instance list (C)” on page 526.
- For a C++ example, see “Create a process instance list (C++)” on page 527.
- For a Java example, see “Create a process instance list (Java)” on page 528.
- For a COBOL example, see “Create a process instance list (COBOL)” on page 531.

CreateProcessTemplateList()

This API call creates a process template list on the MQSeries Workflow execution server so that process templates can be grouped to one's own taste or for a group of users (action call).

A process template list is identified by:
- Its name, which is unique per type
- Its type, that is, an indicator whether the list is for public or private usage
- Its owner, that is, the owner of the list when the type is private

If the list is for public usage, any owner specification is ignored. If the list is for private usage and no owner is provided, then the list is created for the logged-on user.

When the process template list is to be created for public usage or for the private usage of another user, that is, not the logged-on user itself, then the logged-on user needs to have staff definition authorization.

A process template list groups a set of process templates which have the same characteristics. These characteristics are defined via filters. The number of process templates in the list can be restricted via a threshold which specifies the maximum number of process templates to be returned to the client. That threshold is applied after the process template list has been sorted according to sort criteria specified. Process templates are sorted on the server, that is, the code page of the server determines the sort sequence.

The following rules apply for specifying a process template list name:
- You can specify a maximum of 32 characters.
- You can use any printable characters depending on your current locale, except the following:

  `* ? " ; : .`
- You can use blanks with these restrictions: no leading blanks, no trailing blanks, and no consecutive blanks.

The following rules apply for specifying a description:
- You can specify a maximum of 254 characters.
- You can use any printable characters depending on your current locale, including the end-of-line and new-line characters.

A process template list filter is specified as a character string containing a filter on process templates (refer to "How to read the syntax diagrams" on page xii).

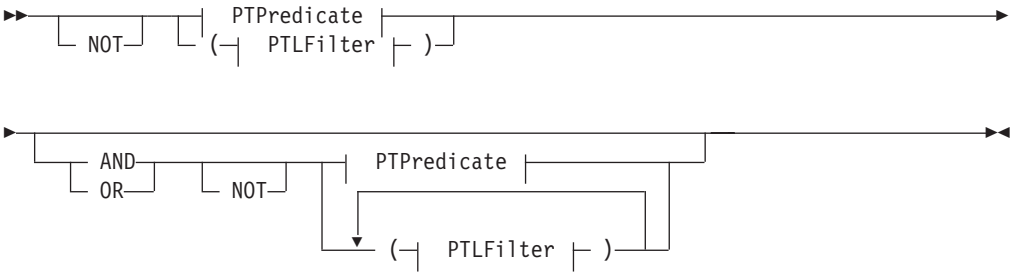
Notes:

1. A *string* constant is to be enclosed in single quotes (').

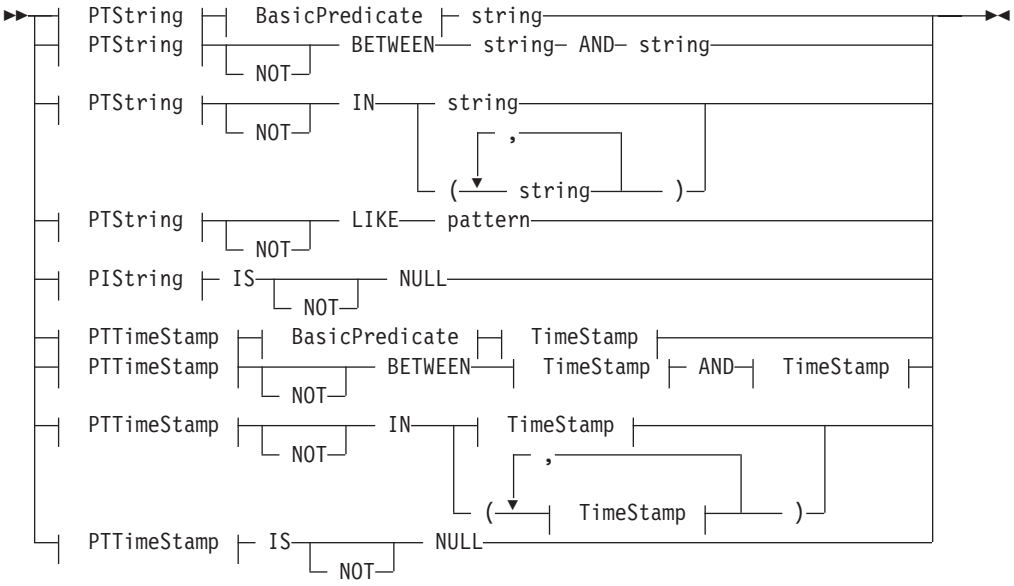
   A *pattern* is a string constant in which the asterisk and the question mark have special meanings.
   - The question mark (?) represents any single character.
   - The asterisk (*) represents a string of zero or more characters.
   - The escape character is backslash (\) and must be used when the pattern itself contains actual question marks or asterisks.
2. Optional specifications in the *TimeStamp* are set to 0 (zero) if not specified.

ExecutionService

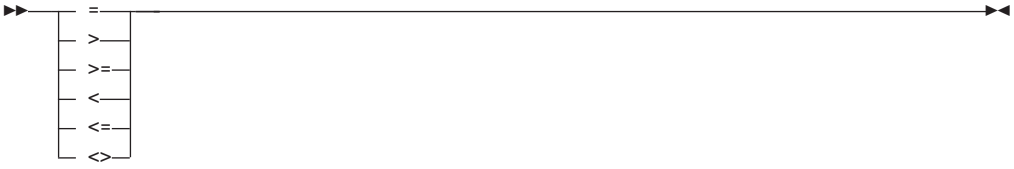
PTLFilter



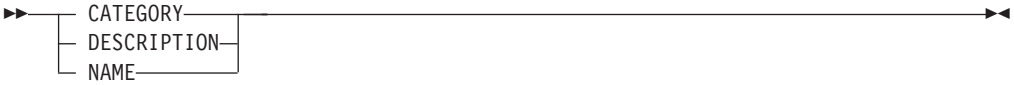
PTPredicate



BasicPredicate

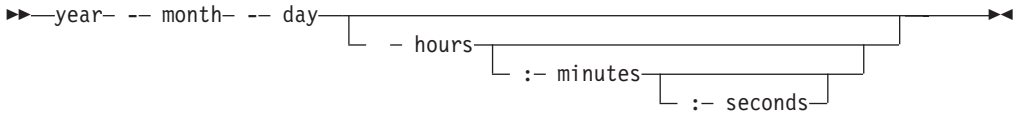


PTString



PTTimeStamp

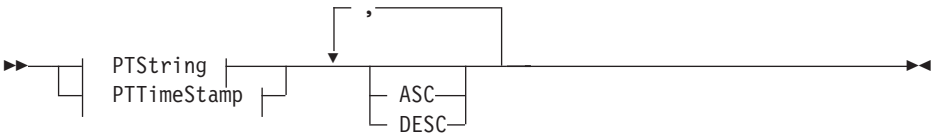
TimeStamp



A process template list sort criterion is specified as a character string.

Note: The default sort order is ascending.

PTLOrderBy



Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

None or staff definition or be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjExecutionServiceCreateProcessTemplateList(
       FmcjExecutionServiceHandle         service,
       char const *                       name,
       enum FmcjPersistentListTypeOfList  type,
       char const *                       owner,
       char const *                       description,
       char const *                       filter,
       char const *                       sortCriteria,
       unsigned long *                    threshold,
       FmcjProcessTemplateListHandle *    newList )
```

C++

```
APIRET CreateProcessTemplateList(
       string const &                  name,
       FmcjPersistentList::TypeOfList  type,
       string const *                  owner,
       string const *                  description,
       string const *                  filter,
       string const *                  sortCriteria,
       unsigned long const *           threshold,
       FmcjProcessTemplateList &       newList ) const
```

Java

```
public abstract
ProcessTemplateList createProcessTemplateList(
       String                          name,
       TypeOfList                      type,
       String                          owner,
       String                          description,
       String                          filter,
       String                          sortCriteria,
       Integer                         threshold   ) throws FmcException
```

COBOL

```
        FmcjESCreateProcTemplList.

           CALL    "FmcjExecutionServiceCreateProcessTemplateList"
                         USING
                         BY VALUE
                            serviceValue
                            name
                            typeValue
                            ownerValue
                            description
                            filter
                            sortCriteria
                            threshold
                         BY REFERENCE
                            newList
                         RETURNING
                            intReturnValue.
```

Parameters

description Input. A user-defined description of the process template list.

filter Input. The filter criteria which characterize the process templates in the process template list.

name Input. A user-defined name for the process template list.

newList Input/Output. The newly created process template list.

owner Input. The owner of the list when the type is private. Ignored for public lists.

service Input. A handle to the service object representing the session with the execution server.

sortCriteria Input. The sort criteria to be applied to the process templates in the process template list.

threshold Input. The threshold which defines the maximum number of process templates in the process template list.

type Input. An indication whether a private or a public list is to be created.

Return type

long/ APIRET The return code from this API call - see return codes below.

ProcessTemplateList

The newly created process template list.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)

A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)

The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_INVALID_DESCRIPTION(810)

The specified description is invalid.

FMC_ERROR_INVALID_FILTER(125)

The specified filter is invalid.

FMC_ERROR_INVALID_LIST_TYPE(813)

The specified list type is invalid.

FMC_ERROR_INVALID_NAME(134)

The specified process template list name does not comply with the syntax rules.

FMC_ERROR_INVALID_USER(132)

The user ID specified for the owner of the list does not conform to the syntax rules.

FMC_ERROR_INVALID_SORT(808)

The specified sort criteria are invalid.

FMC_ERROR_INVALID_THRESHOLD(807)

The specified threshold is invalid; exceeds the maximum possible value.

FMC_ERROR_NOT_LOGGED_ON(106)

Not logged on.

FMC_ERROR_NOT_AUTHORIZED(119)

Not authorized.

FMC_ERROR_OWNER_NOT_FOUND(812)

The person to become the owner of the process template list is not found.

FMC_ERROR_NOT_UNIQUE(121)
The name of the process template list is not unique within the specified type.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples
- For a C example, see "Create a process instance list (C)" on page 526.
- For a C++ example, see "Create a process instance list (C++)" on page 527.
- For a Java example, see "Create a process instance list (Java)" on page 528.
- For a COBOL example, see "Create a process instance list (COBOL)" on page 531.

CreateWorklist()

This API call creates a worklist on the MQSeries Workflow execution server so that work items or notifications can be grouped to one's own taste or for a group of users (action call).

A worklist is identified by:
- Its name, which is unique per type
- Its type, that is, an indicator whether the list is for public or private usage
- Its owner, that is, the owner of the list when the type is private

If the list is for public usage, any owner specification is ignored. If the list is for private usage and no owner is provided, then the list is created for the logged-on user.

When the worklist is to be created for public usage or for the private usage of another user, that is, not the logged-on user itself, then the logged-on user needs to have staff definition authorization.

A worklist groups a set of work items or notifications which have the same characteristics. These characteristics are defined via filters. The number of items in the worklist can be restricted via a threshold which specifies the maximum number of items to be returned to the client. That threshold is applied after the worklist has been sorted according to sort criteria specified. Items are sorted on the server, that is, the code page of the server determines the sort sequence.

The following rules apply for specifying a worklist name:
- You can specify a maximum of 32 characters.
- You can use any printable characters depending on your current locale, except the following:

  ```
  * ? " ; : .
  ```
- You can use blanks with these restrictions: no leading blanks, no trailing blanks, and no consecutive blanks.

The following rules apply for specifying a description:

- You can specify a maximum of 254 characters.
- You can use any printable characters depending on your current locale, including the end-of-line and new-line characters.

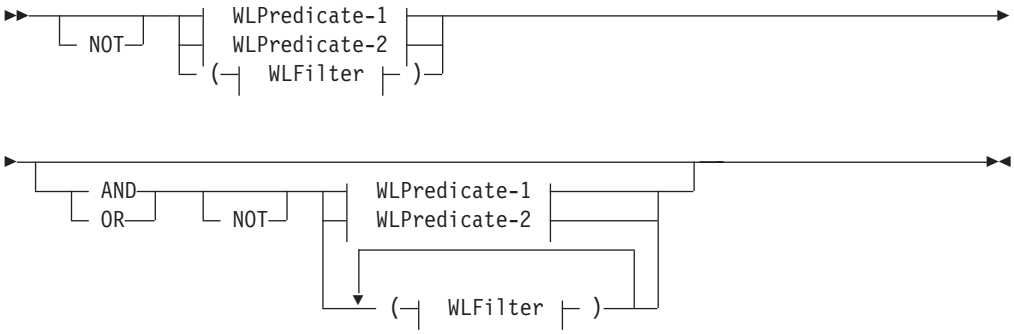
A worklist filter is specified as a character string containing a filter on the items in the worklist (refer to "How to read the syntax diagrams" on page xii).

Notes:

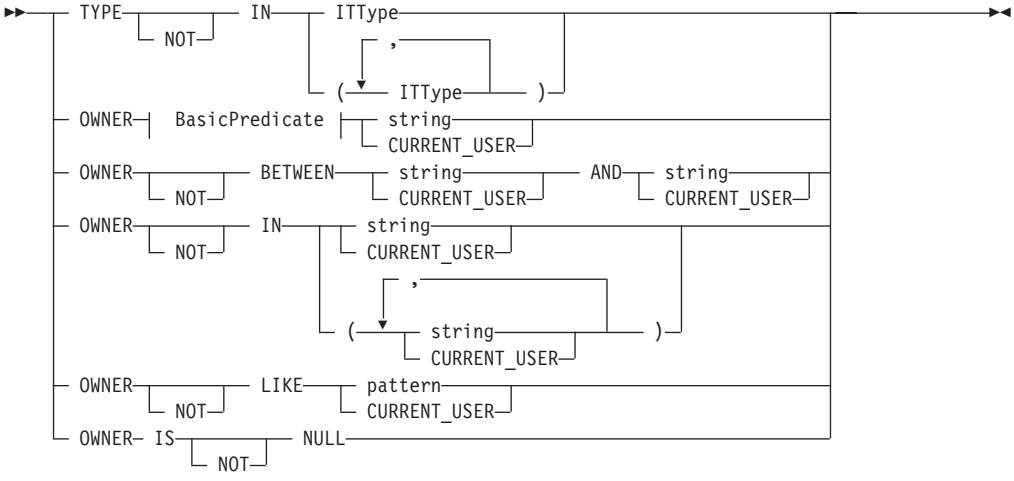
1. A *string* constant is to be enclosed in single quotes (').

   A *pattern* is a string constant in which the asterisk and the question mark have special meanings.
   - The question mark (?) represents any single character.
   - The asterisk (*) represents a string of zero or more characters.
   - The escape character is backslash (\) and must be used when the pattern itself contains actual question marks or asterisks.
2. Optional specifications in the *TimeStamp* are set to 0 (zero) if not specified.

WLFilter

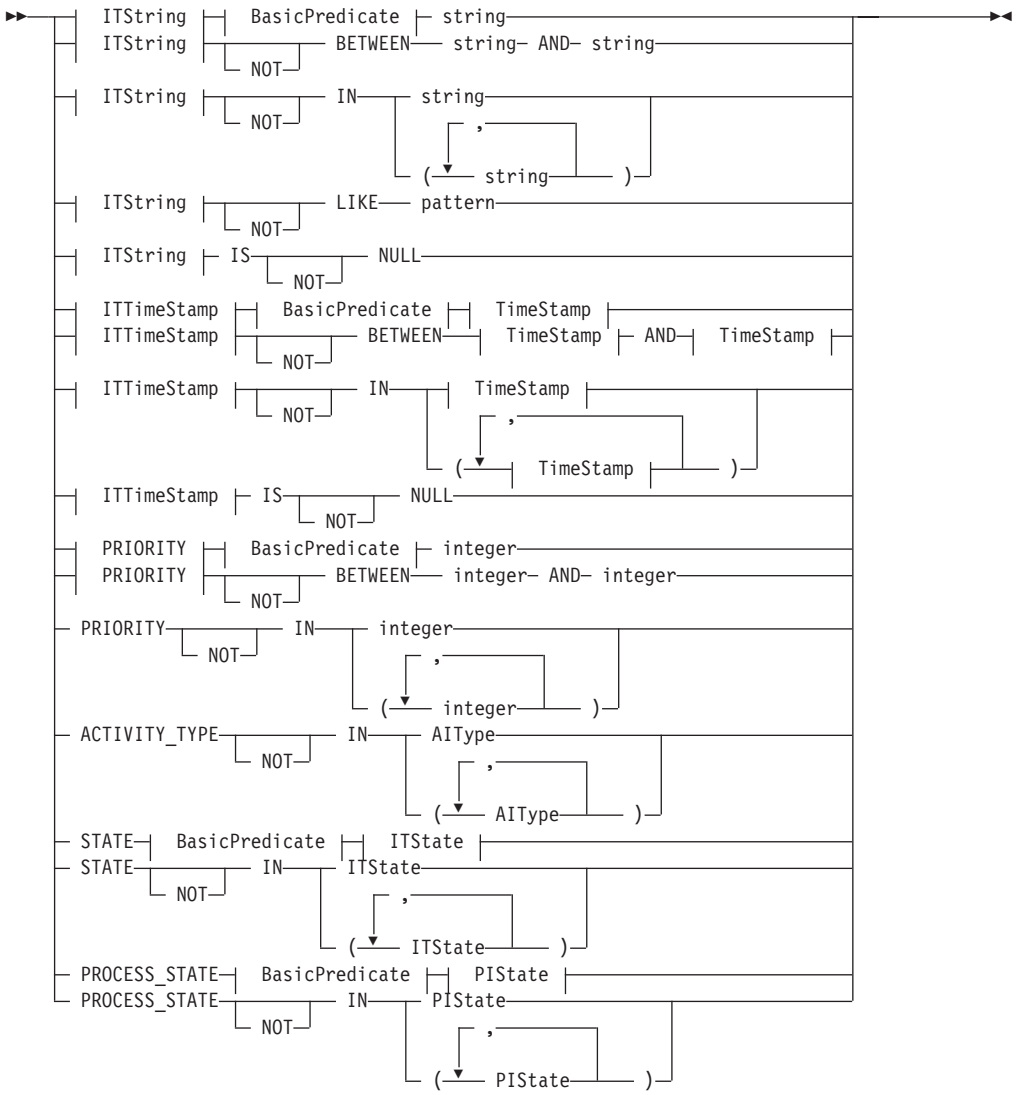


WLPredicate-1

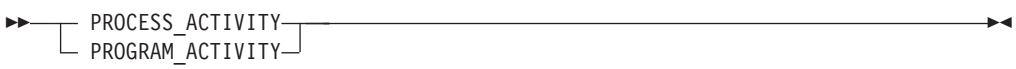


WLPredicate-2

ExecutionService



AIType

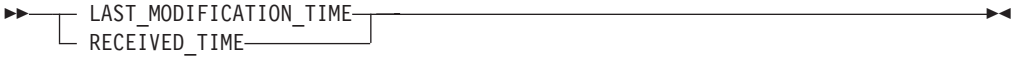


BasicPredicate

ITState

ITString

ITTimeStamp

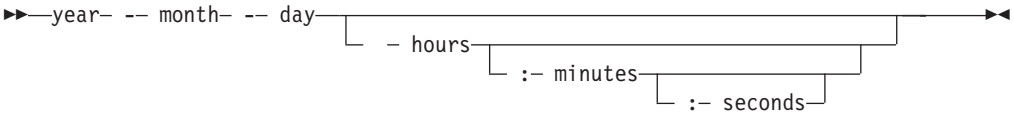


ITType

PIState

TimeStamp

ExecutionService



A worklist sort criterion is specified as a character string.

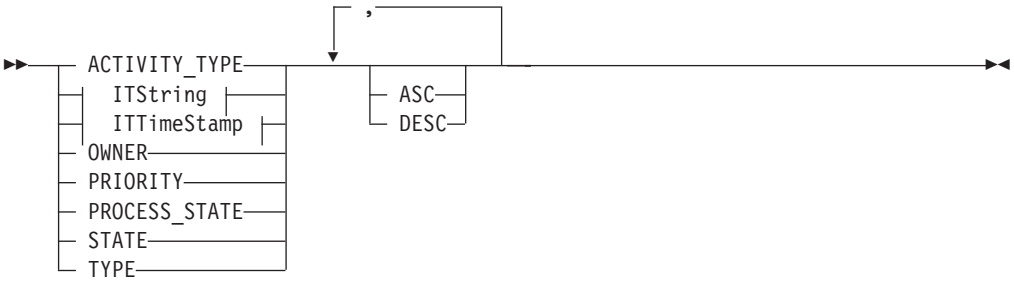
Note: The default sort order is ascending.

Activity types are sorted according to the sequence shown in the AIType diagram.

Item types are sorted according to the sequence shown in the ITType diagram.

States are sorted according to the sequence shown in the ITState or the PIState diagram.

WLOrderBy



Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

None or staff definition or be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjExecutionServiceCreateWorklist(
       FmcjExecutionServiceHandle         service,
       char const *                       name,
       enum FmcjPersistentListTypeOfList  type,
       char const *                       owner,
       char const *                       description,
       char const *                       filter,
       char const *                       sortCriteria,
       unsigned long *                    threshold,
       FmcjWorklistHandle *               newList )
```

C++

```
APIRET CreateWorklist(
       string const &                  name,
       FmcjPersistentList::TypeOfList  type,
       string const *                  owner,
       string const *                  description,
       string const *                  filter,
       string const *                  sortCriteria,
       unsigned long const *           threshold,
       FmcjWorklist &                  newList ) const
```

Java

```
public abstract
WorkList createWorkList(
       String                          name,
       TypeOfList                      type,
       String                          owner,
       String                          description,
       String                          filter,
       String                          sortCriteria,
       Integer                         threshold   ) throws FmcException
```

COBOL

```
        FmcjESCreateWorklist.

           CALL    "FmcjExecutionServiceCreateWorklist"
                          USING
                          BY VALUE
                             serviceValue
                             name
                             typeValue
                             ownerValue
                             description
                             filter
                             sortCriteria
                             threshold
                          BY REFERENCE
                             newList
                          RETURNING
                             intReturnValue.
```

Parameters

description Input. A user-defined description of the worklist.
filter Input. The filter criteria which characterize the items in the worklist.
name Input. A user-defined name for the worklist.
newList Input/Output. The newly created worklist.
owner Input. The owner of the list when the type is private. Ignored for public lists.
service Input. A handle to the service object representing the session with the execution server.
sortCriteria Input. The sort criteria to be applied to the items in the worklist.
threshold Input. The threshold which defines the maximum number of items in the worklist.
type Input. An indication whether a private or a public list is to be created.

Return type

long/ APIRET The return code from this API call - see return codes below.
WorkList The newly created worklist.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.
FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.
FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_INVALID_DESCRIPTION(810)
The specified description is invalid.
FMC_ERROR_INVALID_FILTER(125)
The specified filter is invalid.
FMC_ERROR_INVALID_LIST_TYPE(813)
The specified list type is invalid.
FMC_ERROR_INVALID_NAME(134)
The specified worklist name does not comply with the syntax rules.
FMC_ERROR_INVALID_USER(132)
The user ID specified for the owner of the list does not conform to the syntax rules.
FMC_ERROR_INVALID_SORT(808)
The specified sort criteria are invalid.
FMC_ERROR_INVALID_THRESHOLD(807)
The specified threshold is invalid; exceeds the maximum possible value.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized.
FMC_ERROR_OWNER_NOT_FOUND(812)
The person to become the owner of the worklist is not found.
FMC_ERROR_NOT_UNIQUE(121)
The name of the worklist is not unique within the specified type.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples
- For a C example, see "Create a process instance list (C)" on page 526.
- For a C++ example, see "Create a process instance list (C++)" on page 527.
- For a Java example, see "Create a process instance list (Java)" on page 528.
- For a COBOL example, see "Create a process instance list (COBOL)" on page 531.

Logoff()

This API call allows the application to finish the specified user session with an MQSeries Workflow execution server (action call).

When logoff has been successfully executed, no further client/server calls are accepted using this execution service object.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjExecutionServiceLogoff(
       FmcjExecutionServiceHandle service )
```

C++

```
APIRET Logoff()
```

Java

```
public abstract
void   logoff() throws FmcException
```

COBOL

```
         FmcjESLogoff.

            CALL    "FmcjExecutionServiceLogoff"
                           USING
                           BY VALUE
                              serviceValue
                           RETURNING
                              intReturnValue.
```

Parameters

service Input. A handle to the service object representing the session with the execution server.

Return type

long/ APIRET

The return code from this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)

A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)

The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_NOT_LOGGED_ON(106)

Not logged on.

FMC_ERROR_COMMUNICATION(13)

The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)

An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)

An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)

Timeout has occurred.

Examples

For examples see “Chapter 6. Examples” on page 525.

Logon()

This API call allows an application to establish a user session with an MQSeries Workflow execution server (action call).

A successful Logon() is the prerequisite for using all other action and program execution management API calls of the MQSeries Workflow API.

The user ID to log on with must be a registered MQSeries Workflow user.

When the execution server supports *unified logon*, an empty password and user ID can be provided. The user ID to log on with is then retrieved from the operating system, that is, logon must have been performed at the client. The client is trusted and the execution server performs no password checking.

After a successful logon, the execution service object represents that single user session. A further request to log on with a different user ID will be rejected. You can, however, establish as many sessions as needed, even for the same user, using different execution service objects, one for each session.

At logon time, you can specify your mode of operation. When you are operating in the *present* session mode, the execution server can assume that you are able to react to requests from activity implementations which might ask, for example, for container data. Thus, activity instances that are started automatically may be scheduled on your behalf - provided that you also started a program execution agent.[5]

Furthermore, the *present* mode indicates to MQSeries Workflow that the session can handle unsolicited messages pushed by the execution server - see "The push data access model" on page 16 for additional prerequisites.

There can only be a single present session for one user. The *present here* option can be used, to force that other present session logoff and to newly establish a present session here.

When you are operating in a *default* session mode, the execution server does not assume that you are able to react. Activity instances are not automatically started on your behalf and messages are not pushed to you. There can be multiple sessions for one user with the *default* session mode.

The following enumeration types can be used to specify the session mode:

C	FmcjServiceSessionMode
C++	FmcjService::SessionMode
Java	com.ibm.workflow.api.ServicePackage.SessionMode

The enumeration constants can take the following values; it is strongly advised to use the symbolic names instead of the associated integer values.

Default Indicates that you want to operate in a default, nonpresent, session mode.

C	Fmc_SM_Default
C++	FmcjService::Default or FmcjExecutionService::Default
Java	SessionMode.DEFAULT
COBOL	Fmc-SM-Default

Present Indicates that you want to operate in a present session mode.

5. This is not an option under OS/390.

	C	Fmc_SM_Present
	C++	FmcjService::Present or FmcjExecutionService::Present
	Java	SessionMode.PRESENT
	COBOL	Fmc-SM-Present

PresentHere Indicates that you want to operate in a present session mode. If a session with the present session mode already exists, then it should be logged off.

	C	Fmc_SM_PresentHere
	C++	FmcjService::PresentHere or FmcjExecutionService::PresentHere
	Java	SessionMode.PRESENT_HERE
	COBOL	Fmc-SM-PresentHere

At logon time, you can also specify whether you are back in case you are set to be absent. When you are not absent you participate in work assignment; otherwise no work items are assigned to you.

The following enumeration types can be used to deal with your absence:

C	FmcjServiceAbsenceIndicator
C++	FmcjService::AbsenceIndicator
Java	com.ibm.workflow.api.ServicePackage.AbsenceIndicator

The enumeration constants can take the following values; it is strongly advised to use the symbolic names instead of the associated integer values.

NotSet Indicates that no value is specified. This means that the definition in your person record applies. Your absence is reset or not according to the definition found there.

C	Fmc_SA_NotSet
C++	FmcjService::NotSet or FmcjExecutionService::NotSet
Java	AbsenceIndicator.NOT_SET
COBOL	Fmc-SA-NotSet

Reset Indicates that your absence setting is to be reset; you are back.

C	Fmc_SA_Reset
C++	FmcjService::Reset or FmcjExecutionService::Reset
Java	AbsenceIndicator.RESET
COBOL	Fmc-SA-Reset

Leave Indicates that your absence setting should stay as is; you are either absent or not.

C	Fmc_SA_Leave
C++	FmcjService::Leave or FmcjExecutionService::Leave
Java	AbsenceIndicator.LEAVE
COBOL	Fmc-SA-Leave

For Java programs, logon2() allows for the specification of the session mode and absence setting.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

Be a registered MQSeries Workflow user

Required connection

None

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjExecutionServiceLogon (
       FmcjExecutionServiceHandle        service,
       char const *                      userID,
       char const *                      password,
       enum FmcjServiceSessionMode       sessionMode,
       enum FmcjServiceAbsenceIndicator  absenceIndicator )
```

C++

```
APIRET Logon( string const & userID, string const & password )

APIRET Logon(
       string const &                    userID,
       string const &                    password,
       SessionMode                       sessionMode = Present,
       AbsenceIndicator                  absenceIndicator = NotSet )
```

Java

```
public abstract
void   logon ( String userID,   String password )

public abstract
void   logon2( String           userID,
               String           password,
               SessionMode      sessionMode,
               AbsenceIndicator absenceIndicator ) throws FmcException
```

COBOL

```
FmcjESLogon.

   CALL    "FmcjExecutionServiceLogon"
                  USING
                  BY VALUE
                     serviceValue
                     userID
                     passwordValue
                     sessionMode
                     absenceIndicator
                  RETURNING
                     intReturnValue.
```

Parameters

absenceIndicator
: Input. An indicator to state how to handle any absence set.

password
: Input. The password of the user. Can be empty for unified logon.

service
: Input. A handle to the service object representing the session to be established with the execution server.

sessionMode
: Input. The mode of the session to be established.

userID
: Input. The user ID of the user on whose behalf a logon is to be made. Can be empty for unified logon.

Return type

long/ APIRET

The return code from this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0)
: The API call completed successfully.

FMC_ERROR(1)
: A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)
: The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_ALREADY_LOGGED_ON(11)
: The user is already logged on with present mode or the execution service object already represents a different user session.

FMC_ERROR_BACK_LEVEL_VERSION(504)
: The version of the client is out-of-date, that is, not supported by this server.

FMC_ERROR_INVALID_ABSENCE_SPEC(905)
: An unknown absence setting has been specified.

FMC_ERROR_INVALID_SESSION_MODE(901)
: An unknown session mode has been specified.

FMC_ERROR_NEWER_VERSION(505)
: The version of the client is newer than the server version, that is, not supported.

FMC_ERROR_PASSWORD(12)
: Incorrect password.

FMC_ERROR_PROFILE(124)
: Required user or workstation profile entries cannot be found.

FMC_ERROR_USERID_UNKNOWN(10)
No user ID registered with MQSeries Workflow has been provided.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples

For examples see "Chapter 6. Examples" on page 525.

Passthrough()

This API call can be used by an activity implementation to establish a user session with an MQSeries Workflow execution server from within this program (activity implementation).

When successfully executed, a session is set up to the same execution server from which the work item implemented by this program was started; the user on whose behalf the session is set up is the same one on whose behalf the work item was started.

Note: This call will fail after the COMMAREA or IMS I/O Area has been changed with SetOutContainer() or SetRemoteOutContainer().

Usage notes
- See "Activity implementation API calls" on page 122 for general information.

Authorization

Activity implementation started by MQSeries Workflow

Required connection

None, but MQSeries Workflow program execution server must be active.

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjExecutionServicePassthrough(
       FmcjExecutionServiceHandle service )
```

C++

```
APIRET Passthrough()
```

Java

```
public abstract
void passthrough()  throws FmcException
```

COBOL

```
        FmcjESPassthrough.

           CALL    "FmcjExecutionServicePassthrough"
                          USING
                          BY VALUE
                             serviceValue
                          RETURNING
                             intReturnValue.
```

Parameters

service Input. A handle to the service object which is to represent the session to be established with the execution server.

Return type

long/ APIRET The return code from this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_PROGRAM_EXECUTION(126)
Passthrough was not called from within an activity implementation, or the program execution server is not active.

FMC_ERROR_TOOL_FUNCTION(128)
Passthrough cannot be called from a program started by the program execution server.

FMC_ERROR_USERID_UNKNOWN(10)
The user who started the work item no longer exists.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples
- For a C example, see "Programming an activity implementation (C)" on page 573.
- For a C++ example, see "Programming an activity implementation (C++)" on page 574.
- For a COBOL example, see "Programming an activity implementation (COBOL)" on page 575.

QueryActivityInstanceNotifications()

This API call retrieves the activity instance notifications the user has access to from the MQSeries Workflow execution server (action call).

In C, C++, and COBOL, any activity instance notifications retrieved are appended to the supplied vector. If you want to read the current activity instance notifications only, you have to clear the vector before you issue this API call. This means that you should set the vector handle to 0 in C or COBOL, or erase all elements of the vector in the C++ API.

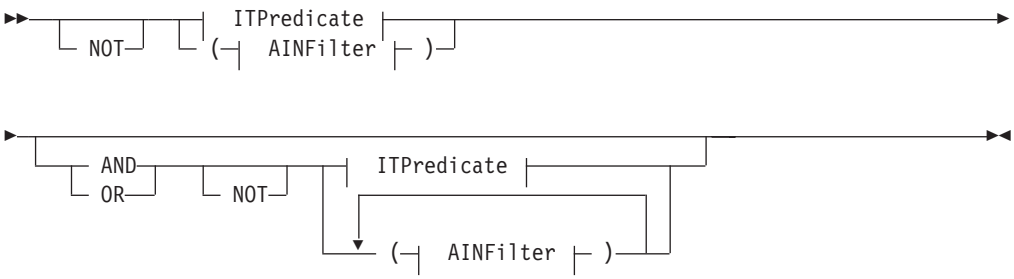
The activity instance notifications to be retrieved can be characterized by a filter. An activity instance notification filter is specified as a character string:

Notes:

1. A *string* constant is to be enclosed in single quotes (').

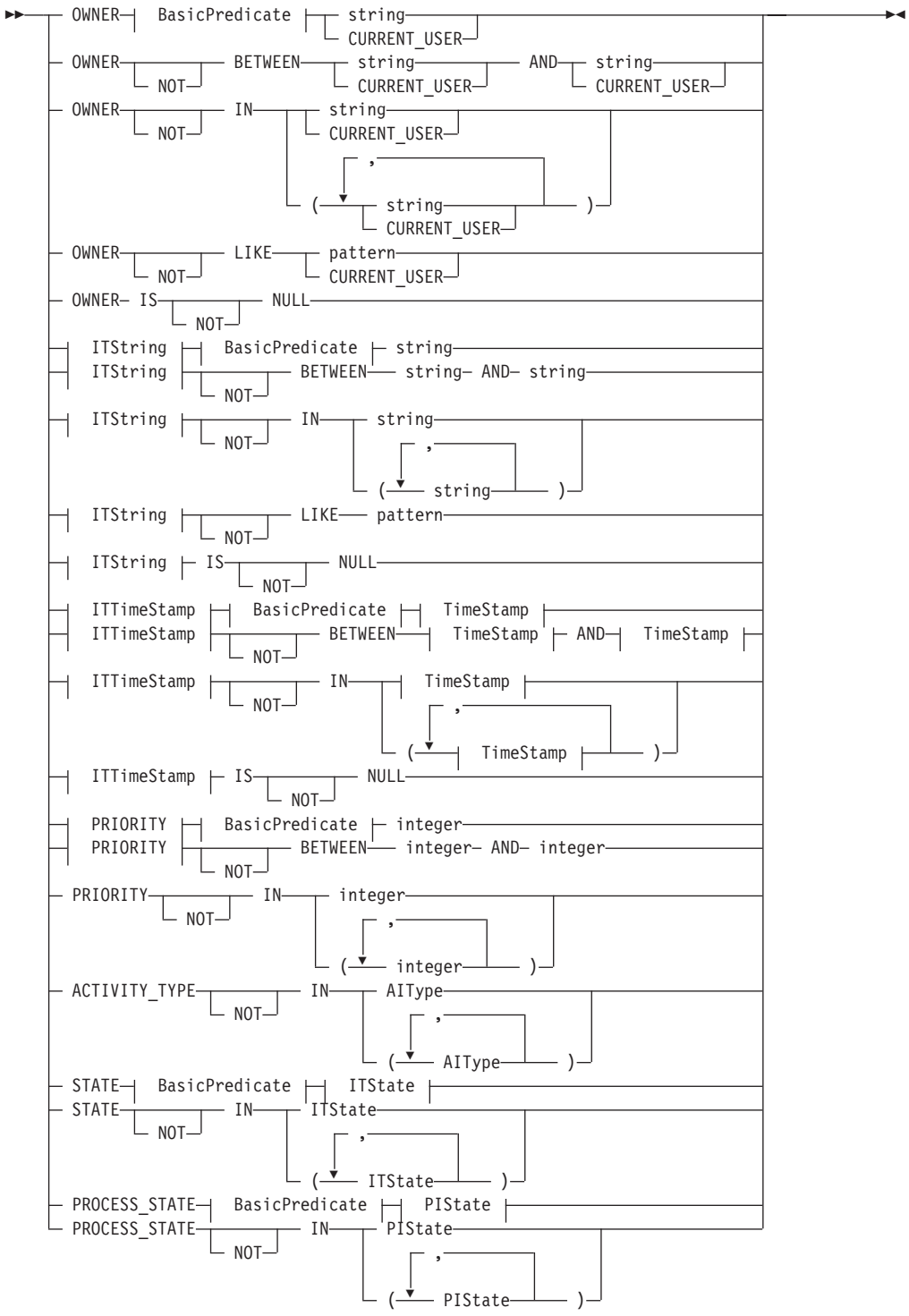
   A *pattern* is a string constant in which the asterisk and the question mark have special meanings.
   - The question mark (?) represents any single character.
   - The asterisk (*) represents a string of zero or more characters.
   - The escape character is backslash (\) and must be used when the pattern itself contains actual question marks or asterisks.
2. Optional specifications in the *TimeStamp* are set to 0 (zero) if not specified.

AINFilter



ITPredicate

ExecutionService



AIType

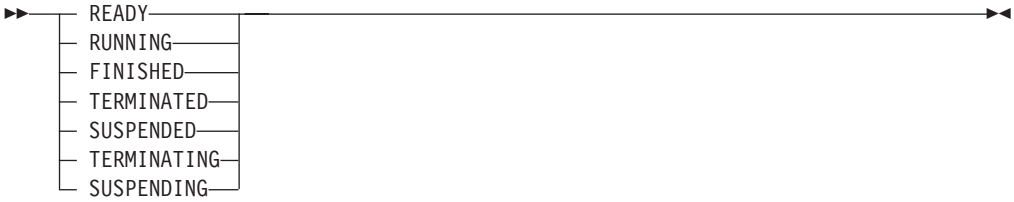
BasicPredicate

ITState

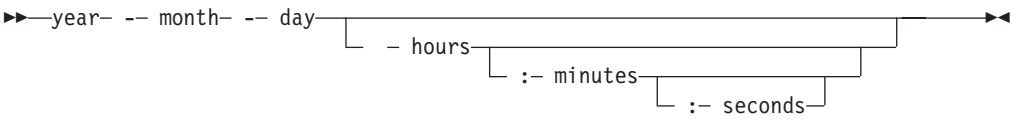
ITString

ITTimeStamp

PIState



TimeStamp



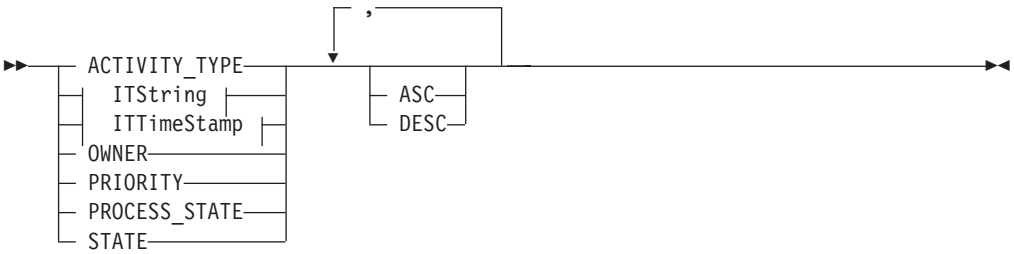
Activity instance notifications can be sorted. An activity instance notification sort criterion is specified as a character string.

Note: The default sort order is ascending.

Activity types are sorted according to the sequence shown in the AIType diagram.

States are sorted according to the sequence shown in the ITState or the PIState diagram.

AINOrderBy



The number of activity instance notifications to be retrieved can be restricted via a threshold which specifies the maximum number of activity instance notifications to be returned to the client. That threshold is applied after the activity instance notifications have been sorted according to the sort criteria specified. Note that the activity instance notifications are sorted on the server, that is, the code page of the server determines the sort sequence.

The primary information that is retrieved for each activity instance notification is:
- ActivityType
- Category
- CreationTime
- Description
- Icon
- Implementation
- Kind
- LastModificationTime
- Name
- Owner
- Priority
- ProcessInstanceName
- ReceivedAs
- ReceivedTime
- State

- SupportTools

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
     FmcjExecutionServiceQueryActivityInstanceNotifications(
       FmcjExecutionServiceHandle                    service,
       char const *                                  filter,
       char const *                                  sortCriteria,
       unsigned long const *                         threshold,
       FmcjActivityInstanceNotificationVectorHandle * notifications )
```

C++

```
APIRET QueryActivityInstanceNotifications(
       string const *                            filter,
       string const *                            sortCriteria,
       unsigned long const *                     threshold,
       vector<FmcjActivityInstanceNotification> & notifications ) const
```

Java

```
public abstract
ActivityInstanceNotification[] queryActivityInstanceNotifications(
       String                                    filter,
       String                                    sortCriteria,
       Integer                                   threshold   )
throws FmcException
```

COBOL

```
FmcjESQueryActInstNotifs.

   CALL
      "FmcjExecutionServiceQueryActivityInstanceNotifications"
                  USING
                  BY VALUE
                     serviceValue
                     filter
                     sortCriteria
                     threshold
                  BY REFERENCE
                     notifications
                  RETURNING
                     intReturnValue.
```

Parameters

filter Input. The filter criteria which characterize the activity instance notifications to be retrieved.

notifications Input/Output. The qualifying vector of activity instance notifications.

service Input. A handle to the service object representing the session with the execution server.

sortCriteria Input. The sort criteria to be applied to the activity instance notifications found.

threshold Input. The threshold which defines the maximum number of activity instance notifications to be returned to the client.

Return type

APIRET The return code from this API call - see return codes below.

ActivityInstanceNotification[]
The qualifying activity instance notifications.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_INVALID_FILTER(125)
The specified filter is invalid.

FMC_ERROR_INVALID_SORT(808)
The specified sort criteria are invalid.

FMC_ERROR_INVALID_THRESHOLD(807)
The specified threshold is invalid.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_QRY_RESULT_TOO_LARGE(817)
The number of activity instance notifications to be returned exceeds the maximum size allowed for query results - see the MAXIMUM_QUERY_MESSAGE_SIZE definition in your system, system group, or domain.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples

- For a C example, see "Query process instances (C)" on page 550.
- For a C++ example, see "Query process instances (C++)" on page 552.
- For a Java example, see "Query process instances (Java)" on page 553.
- For a COBOL example, see "Query process instances (COBOL)" on page 556.

QueryItems()

This API call retrieves the work items or notifications the user has access to from the MQSeries Workflow execution server (action call).

In C, C++, and COBOL, any items retrieved are appended to the supplied vector. If you want to read the current items only, you have to clear the vector before you issue this API call. This means that you should set the handle to 0 in C or COBOL, or erase all elements of the vector in the C++ API.

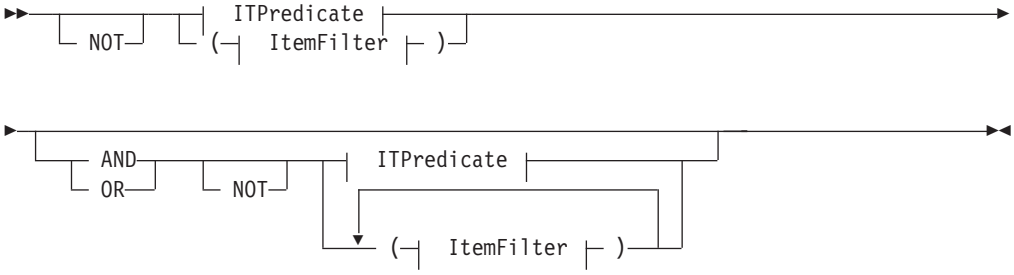
The items to be retrieved can be characterized by a filter. An item filter is specified as a character string.

Notes:

1. A *string* constant is to be enclosed in single quotes (').

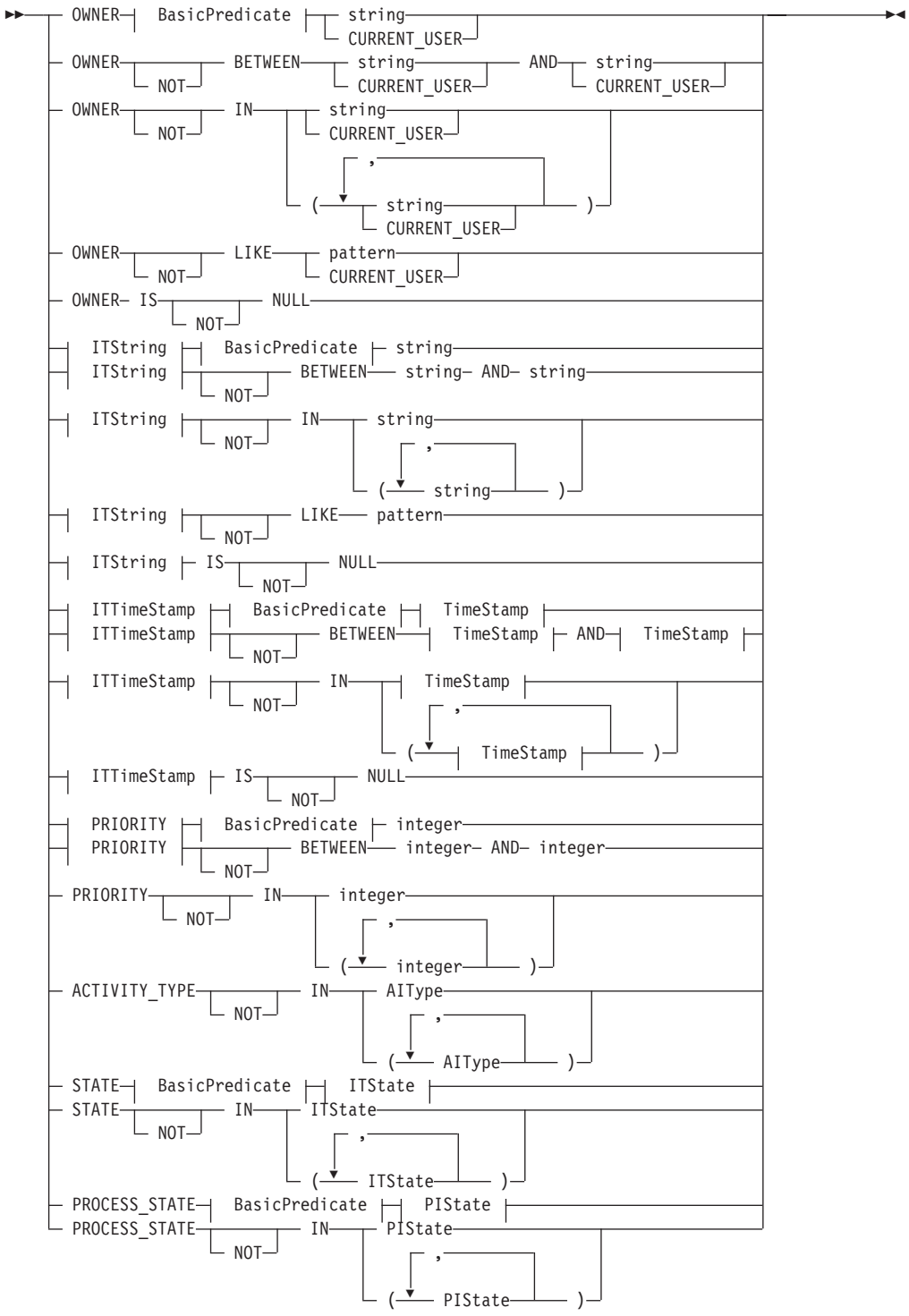
   A *pattern* is a string constant in which the asterisk and the question mark have special meanings.
   - The question mark (?) represents any single character.
   - The asterisk (*) represents a string of zero or more characters.
   - The escape character is backslash (\) and must be used when the pattern itself contains actual question marks or asterisks.
2. Optional specifications in the *TimeStamp* are set to 0 (zero) if not specified.

ItemFilter



ITPredicate

ExecutionService



AIType

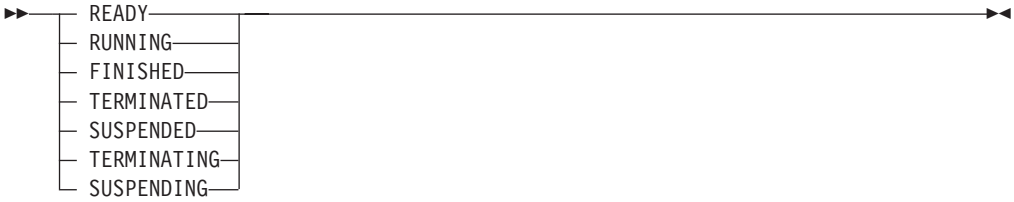
BasicPredicate

ITState

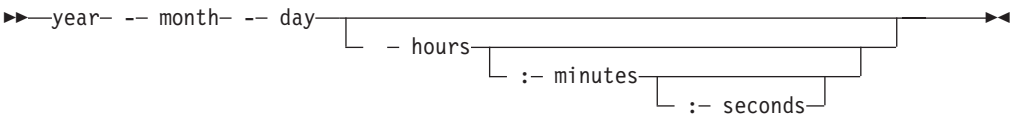
ITString

ITTimeStamp

PIState



TimeStamp



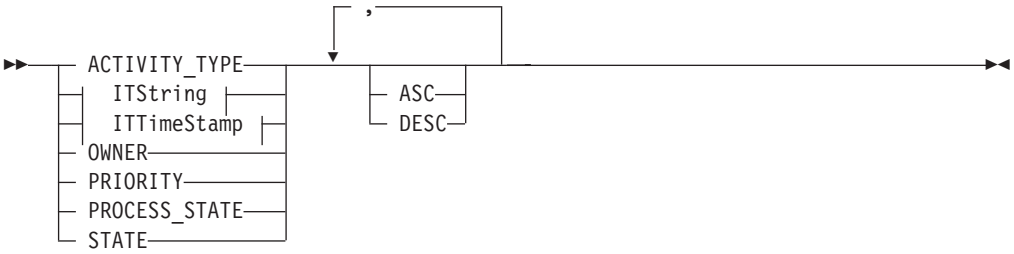
Items can be sorted. An item sort criterion is specified as a character string.

Note: The default sort order is ascending.

Activity types are sorted according to the sequence shown in the AIType diagram.

States are sorted according to the sequence shown in the ITState or the PIState diagram.

ItemOrderBy



The number of items to be retrieved can be restricted via a threshold which specifies the maximum number of items to be returned to the client. That threshold is applied after the items have been sorted according to the sort criteria specified. Note that the items are sorted on the server, that is, the code page of the server determines the sort sequence.

The primary information that is retrieved for each item is:
- ActivityType
- Category
- CreationTime
- Description
- Icon
- Implementation
- Kind
- LastModificationTime
- Name
- Owner
- Priority
- ProcessInstanceName
- ReceivedAs
- ReceivedTime
- StartTime
- State
- SupportTools

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjExecutionServiceQueryItems(
       FmcjExecutionServiceHandle  service,
       char const *                filter,
       char const *                sortCriteria,
       unsigned long const *       threshold,
       FmcjItemHandle *            items )
```

C++

```
APIRET QueryItems(
       string const *             filter,
       string const *             sortCriteria,
       unsigned long const *      threshold,
       vector<FmcjItem> &         items ) const
```

Java

```
public abstract
Item[] queryItems(
       String                     filter,
       String                     sortCriteria,
       Integer                    threshold   ) throws FmcException
```

COBOL

```
FmcjESQueryItems.

   CALL    "FmcjExecutionServiceQueryItems"
                  USING
                  BY VALUE
                     serviceValue
                     filter
                     sortCriteria
                     threshold
                  BY REFERENCE
                     items
                  RETURNING
                     intReturnValue.
```

Parameters

filter Input. The filter criteria which characterize the items to be retrieved.

items Input/Output. The qualifying vector of items.

service Input. A handle to the service object representing the session with the execution server.

sortCriteria Input. The sort criteria to be applied to the items found.

threshold Input. The threshold which defines the maximum number of items to be returned to the client.

Return type

APIRET The return code from this API call - see return codes below.

Item[] The qualifying items.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_INVALID_FILTER(125)
The specified filter is invalid.

FMC_ERROR_INVALID_SORT(808)
The specified sort criteria are invalid.

FMC_ERROR_INVALID_THRESHOLD(807)
The specified threshold is invalid.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_QRY_RESULT_TOO_LARGE(817)
The number of items to be returned exceeds the maximum size allowed for query results - see the MAXIMUM_QUERY_MESSAGE_SIZE definition in your system, system group, or domain.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples
- For a C example, see "Query process instances (C)" on page 550.
- For a C++ example, see "Query process instances (C++)" on page 552.
- For a Java example, see "Query process instances (Java)" on page 553.
- For a COBOL example, see "Query process instances (COBOL)" on page 556.

QueryProcessInstanceLists()

This API call retrieves the process instance lists the user has access to from the MQSeries Workflow execution server (action call).

In C, C++, and COBOL, any process instance lists retrieved are appended to the supplied vector. If you want to read the current process instance lists only, you have to clear the vector before you make this API call. This means that you should set the vector handle to 0 in C or COBOL, or erase all elements of the vector in the C++ API.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjExecutionServiceQueryProcessInstanceLists(
       FmcjExecutionServiceHandle           service,
       FmcjProcessInstanceListVectorHandle * lists )
```

C++

```
APIRET QueryProcessInstanceLists(
       vector<FmcjProcessInstanceList> & lists ) const
```

Java

```
public abstract
ProcessInstanceList[] queryProcessInstanceLists() throws FmcException
```

COBOL

```
         FmcjESQueryProcInstLists.

            CALL    "FmcjExecutionServiceQueryProcessInstanceLists"
                           USING
                           BY VALUE
                              serviceValue
                           BY REFERENCE
                              lists
                           RETURNING
                              intReturnValue.
```

Parameters

lists Input/Output. The vector of process instance lists.

service Input. A handle to the service object representing the session with the execution server.

Return type

long/ APIRET The return code from this API call - see return codes below.

ProcessInstanceList[]
The qualifying process instance lists.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_QRY_RESULT_TOO_LARGE(817)
The number of process instance lists to be returned exceeds the maximum size allowed for query results - see the MAXIMUM_QUERY_MESSAGE_SIZE definition in your system, system group, or domain.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples
- For a C example, see "Query worklists (C)" on page 536.
- For a C++ example, see "Query worklists (C++)" on page 538.
- For a Java example, see "Query worklists (Java)" on page 539.
- For a COBOL example, see "Query worklists (COBOL)" on page 542.

QueryProcessInstanceNotifications()

This API call retrieves the process instance notifications the user has access to from the MQSeries Workflow execution server (action call).

In C, C++, and COBOL, any process instance notifications retrieved are appended to the supplied vector. If you want to read the current process instance notifications only, you have to clear the vector before you issue this API call. This means that you should set the vector handle to 0 in C or COBOL, or erase all elements of the vector in the C++ API.

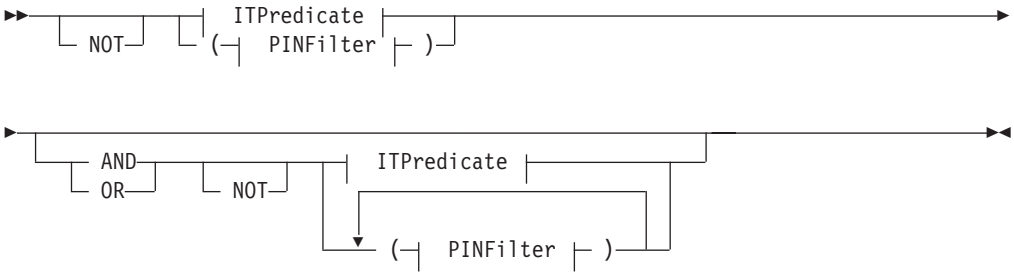
The process instance notifications to be retrieved can be characterized by a filter. A process instance notification filter is specified as a character string.

Notes:

1. A *string* constant is to be enclosed in single quotes (').

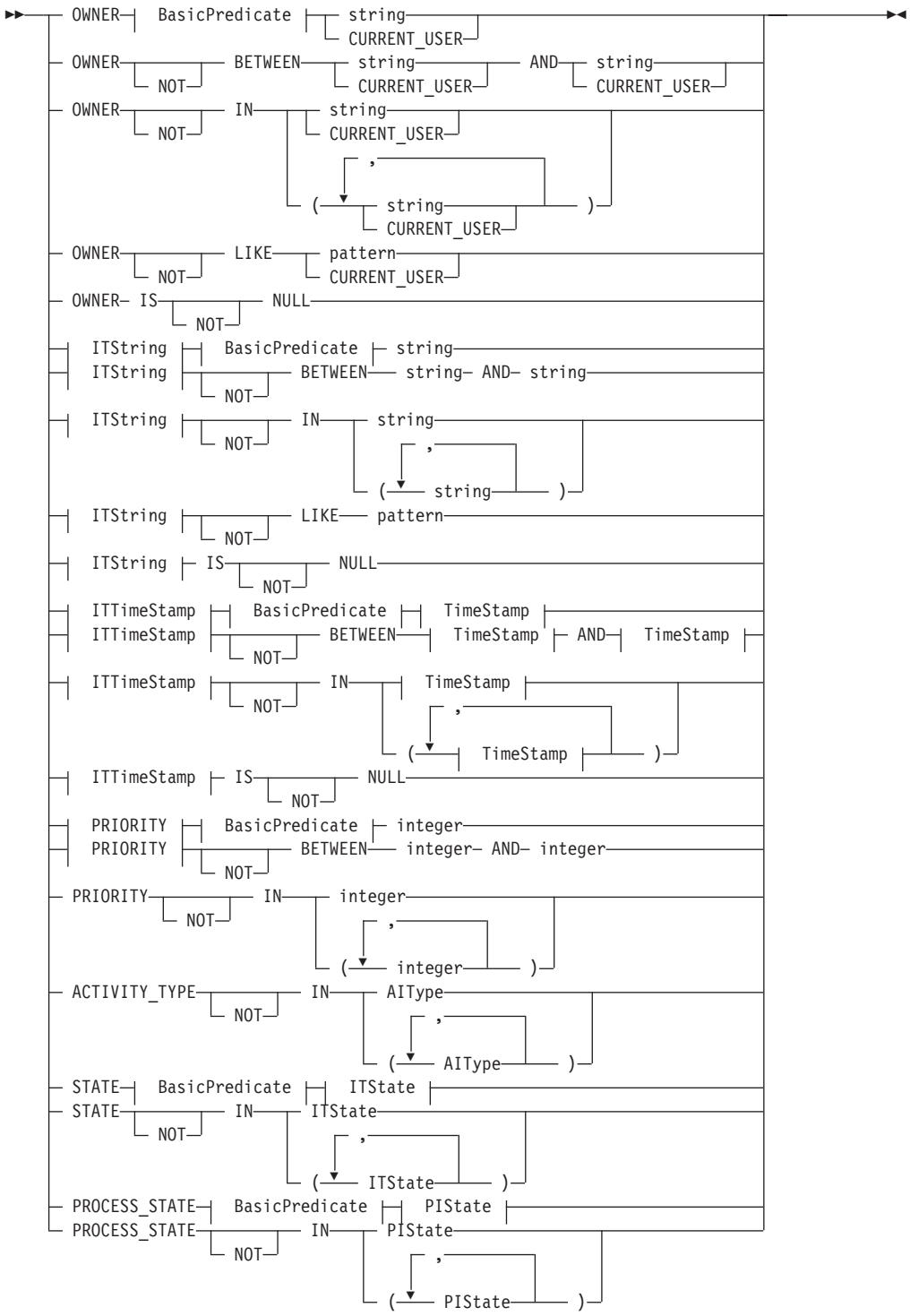
   A *pattern* is a string constant in which the asterisk and the question mark have special meanings.
   - The question mark (?) represents any single character.
   - The asterisk (*) represents a string of zero or more characters.
   - The escape character is backslash (\) and must be used when the pattern itself contains actual question marks or asterisks.
2. Optional specifications in the *TimeStamp* are set to 0 (zero) if not specified.

PINFilter



ITPredicate

ExecutionService



AIType

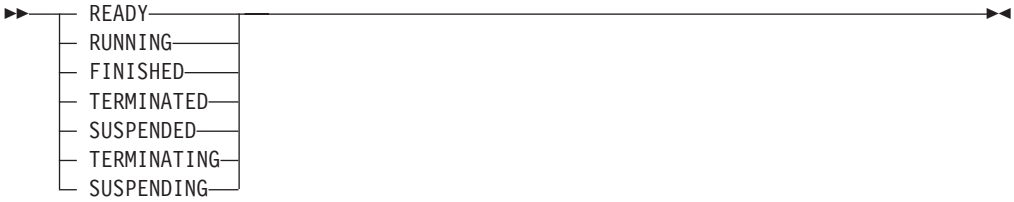
BasicPredicate

ITState

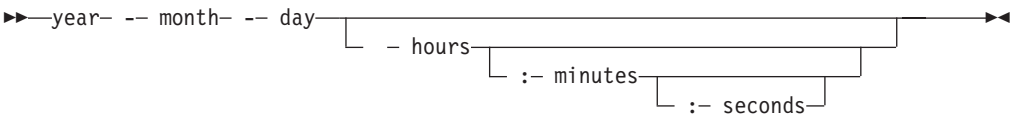
ITString

ITTimeStamp

PIState



TimeStamp



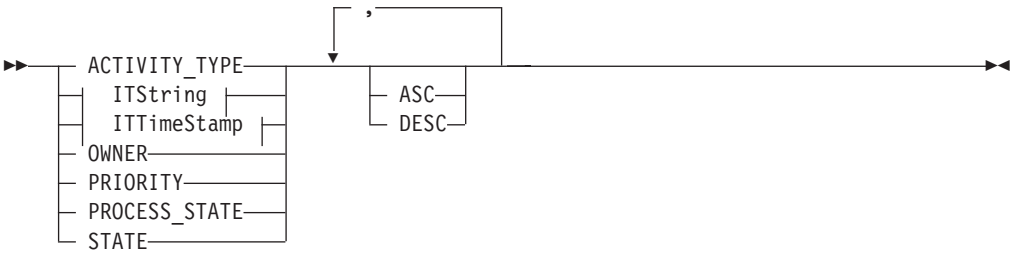
Process instance notifications can be sorted. A process instance notification sort criterion is specified as a character string.

Note: The default sort order is ascending.

Activity types are sorted according to the sequence shown in the AIType diagram.

States are sorted according to the sequence shown in the ITState or the PIState diagram.

PINOrderBy



The number of process instance notifications to be retrieved can be restricted via a threshold which specifies the maximum number of process instance notifications to be returned to the client. That threshold is applied after the activity instance notifications have been sorted according to the sort criteria specified. Note that the process instance notifications are sorted on the server, that is, the code page of the server determines the sort sequence.

The primary information that is retrieved for each process instance notification is:
- Category
- CreationTime
- Description
- Icon
- Kind
- LastModificationTime
- Name
- Owner
- ProcessInstanceName
- ReceivedAs
- ReceivedTime
- StartTime
- State

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjExecutionServiceQueryProcessInstanceNotifications(
       FmcjExecutionServiceHandle                    service,
       char const *                                  filter,
       char const *                                  sortCriteria,
       unsigned long const *                         threshold,
       FmcjProcessInstanceNotificationVectorHandle * notifications )
```

C++

```
APIRET QueryProcessInstanceNotifications(
       string const *                             filter,
       string const *                             sortCriteria,
       unsigned long const *                      threshold,
       vector<FmcjProcessInstanceNotification> & notifications ) const
```

Java

```
public abstract
ProcessInstanceNotification[] queryProcessInstanceNotifications(
       String                      filter,
       String                      sortCriteria,
       Integer                     threshold   ) throws FmcException
```

COBOL

```
FmcjESQueryProcInstNotifs.

   CALL
       "FmcjExecutionServiceQueryProcessInstanceNotifications"
                  USING
                  BY VALUE
                     serviceValue
                     filter
                     sortCriteria
                     threshold
                  BY REFERENCE
                     notifications
                  RETURNING
                     intReturnValue.
```

Parameters

filter Input. The filter criteria which characterize the process instance notifications to be retrieved.

items Input/Output. The qualifying vector of process instance notifications.

service Input. A handle to the service object representing the session with the execution server.

sortCriteria Input. The sort criteria to be applied to the process instance notifications found.

threshold Input. The threshold which defines the maximum number of process instance notifications to be returned to the client.

Return type

APIRET The return code from this API call - see return codes below.

ProcessInstanceNotification[]
The qualifying process instance notifications.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_INVALID_FILTER(125)
The specified filter is not applicable to process instance notifications.

FMC_ERROR_INVALID_SORT(808)
The specified sort criteria are not applicable to process instance notifications.

FMC_ERROR_INVALID_THRESHOLD(807)
The specified threshold is invalid.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_QRY_RESULT_TOO_LARGE(817)
The number of process instance notifications to be returned

exceeds the maximum size allowed for query results - see the MAXIMUM_QUERY_MESSAGE_SIZE definition in your system, system group, or domain.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples

- For a C example, see "Query process instances (C)" on page 550.
- For a C++ example, see "Query process instances (C++)" on page 552.
- For a Java example, see "Query process instances (Java)" on page 553.
- For a COBOL example, see "Query process instances (COBOL)" on page 556.

QueryProcessInstances()

This API call retrieves the current process instances the user has access to from the MQSeries Workflow execution server (action call).

In C, C++, and COBOL, any process instances retrieved are appended to the supplied vector. If you want to read the current process instances only, you have to clear the vector before you issue this API call. This means that you should set the vector handle to 0 in C or COBOL, or erase all elements of the vector in the C++ API.

A filter on process instances is specified as a character string containing a filter predicate:

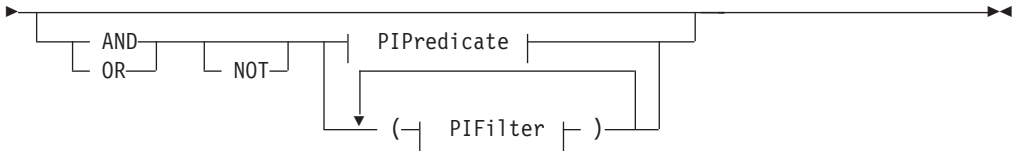
Notes:

1. A *string* constant is to be enclosed in single quotes (').

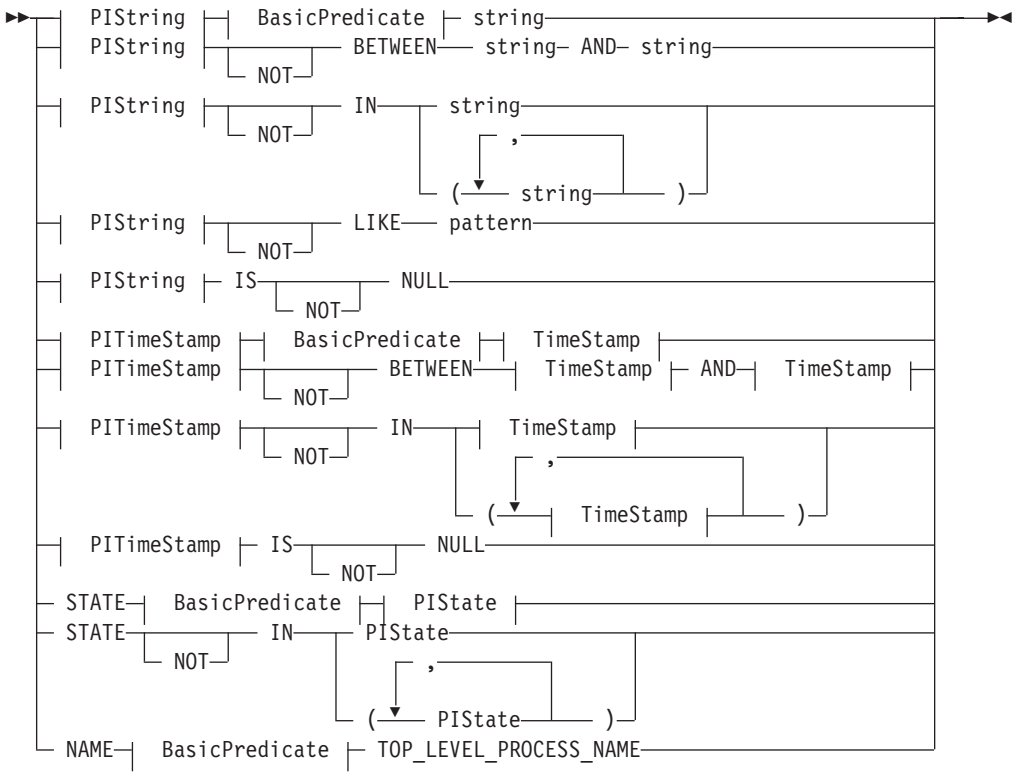
   A *pattern* is a string constant in which the asterisk and the question mark have special meanings.
   - The question mark (?) represents any single character.
   - The asterisk (*) represents a string of zero or more characters.
   - The escape character is backslash (\) and must be used when the pattern itself contains actual question marks or asterisks.
2. Optional specifications in the *TimeStamp* are set to 0 (zero) if not specified.

PIFilter

ExecutionService



PIPredicate



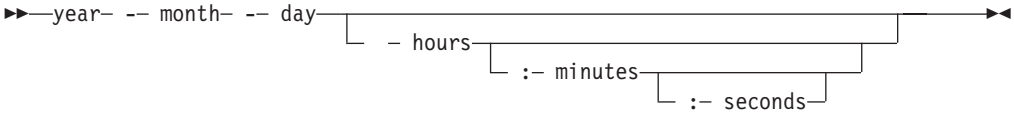
BasicPredicate

PIState

PIString

PITimeStamp

TimeStamp

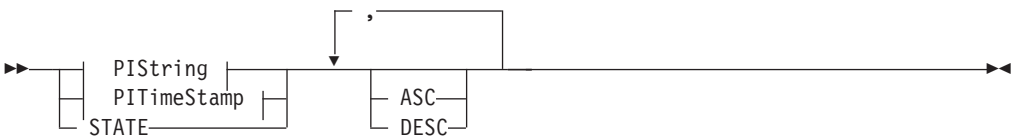


Process instances can be sorted. A process instance sort criterion is specified as a character string.

Note: The default sort order is ascending.

States are sorted according to the sequence shown in the PIState diagram.

PIOrderBy



The number of process instances to be retrieved can be restricted via a threshold which specifies the maximum number of process instances to be returned to the client. That threshold is applied after the process instances have been sorted

according to the sort criteria specified. Note that the process instances are sorted on the server, that is, the code page of the server determines the sort sequence.

The primary information that is retrieved for each process instance is:
- Category
- Description
- Icon
- InContainerNeeded
- LastModificationTime
- LastStateChangeTime
- Name
- ParentName
- ProcessTemplateName
- StartTime
- State
- SuspensionTime
- SystemName
- SystemGroupName
- TopLevelName

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjExecutionServiceQueryProcessInstances(
       FmcjExecutionServiceHandle        service,
       char const *                      filter,
       char const *                      sortCriteria,
       unsigned long const *             threshold,
       FmcjProcessInstanceVectorHandle * instances )
```

C++

```
APIRET QueryProcessInstances(
       string const *                  filter,
       string const *                  sortCriteria,
       unsigned long const *           threshold,
       vector<FmcjProcessInstance> &   instances ) const
```

Java

```
public abstract
ProcessInstance[]  queryProcessInstances(
       String                          filter,
       String                          sortCriteria,
       Integer                         threshold   ) throws FmcException
```

COBOL

```
        FmcjESQueryProcInsts.

           CALL    "FmcjExecutionServiceQueryProcessInstances"
                          USING
                          BY VALUE
                             serviceValue
                             filter
                             sortCriteria
                             threshold
                          BY REFERENCE
                             instances
                          RETURNING
                             intReturnValue.
```

Parameters

filter Input. The filter criteria which characterize the process instances to be retrieved.

instances Input/Output. The qualifying vector of process instances.

service Input. A handle to the service object representing the session with the execution server.

sortCriteria Input. The sort criteria to be applied to the process instances found.

threshold Input. The threshold which defines the maximum number of process instances to be returned to the client.

Return type

APIRET The return code from this API call - see return codes below.

ProcessInstance[]
The qualifying process instances.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_INVALID_FILTER(125)
The specified filter is not applicable to process instances.

FMC_ERROR_INVALID_SORT(808)
The specified sort criteria are not applicable to process instances.

FMC_ERROR_INVALID_THRESHOLD(807)
The specified threshold is invalid.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_QRY_RESULT_TOO_LARGE(817)
The number of process instances to be returned exceeds the maximum size allowed for query results - see the MAXIMUM_QUERY_MESSAGE_SIZE definition in your system, system group, or domain.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples
- For a C example, see "Query process instances (C)" on page 550.
- For a C++ example, see "Query process instances (C++)" on page 552.
- For a Java example, see "Query process instances (Java)" on page 553.
- For a COBOL example, see "Query process instances (COBOL)" on page 556.

QueryProcessTemplateLists()

This API call retrieves the current process template lists the user has access to from the MQSeries Workflow execution server (action call).

In C, C++, and COBOL, any process template lists retrieved are appended to the supplied vector. If you want to read the current process template lists only, you have to clear the vector before you issue this API call. This means that you should set the vector handle to 0 in C or COBOL, or erase all elements of the vector in the C++ API.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjExecutionServiceQueryProcessTemplateLists(
       FmcjExecutionServiceHandle            service,
       FmcjProcessTemplateListVectorHandle * lists )
```

C++

```
APIRET QueryProcessTemplateLists(
       vector<FmcjProcessTemplateList> &  lists ) const
```

Java

```
public abstract
ProcessTemplateList[] queryProcessTemplateLists() throws FmcException
```

COBOL

```
        FmcjESQueryProcTemplLists.

           CALL    "FmcjExecutionServiceQueryProcessTemplateLists"
                          USING
                          BY VALUE
                             serviceValue
                          BY REFERENCE
                             lists
                          RETURNING
                             intReturnValue.
```

Parameters

lists Input/Output. The vector of process template lists.

service Input. A handle to the service object representing the session with the execution server.

Return type

long/ APIRET The return code from this API call - see return codes below.

ProcessTemplateList[]

The qualifying process template lists.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)

A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)

The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_NOT_LOGGED_ON(106)

Not logged on.

FMC_ERROR_QRY_RESULT_TOO_LARGE(817)

The number of process template lists to be returned exceeds the

maximum size allowed for query results - see the MAXIMUM_QUERY_MESSAGE_SIZE definition in your system, system group, or domain.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples
- For a C example, see "Query worklists (C)" on page 536.
- For a C++ example, see "Query worklists (C++)" on page 538.
- For a Java example, see "Query worklists (Java)" on page 539.
- For a COBOL example, see "Query worklists (COBOL)" on page 542.

QueryProcessTemplates()

This API call retrieves the current process templates from the MQSeries Workflow execution server (action call).

In C, C++, and COBOL, any process templates retrieved are appended to the supplied vector. If you want to read the current process templates only, you have to clear the vector before you issue this API call. This means that you should set the vector handle to 0 in C or COBOL, or erase all elements of the vector in the C++ API.

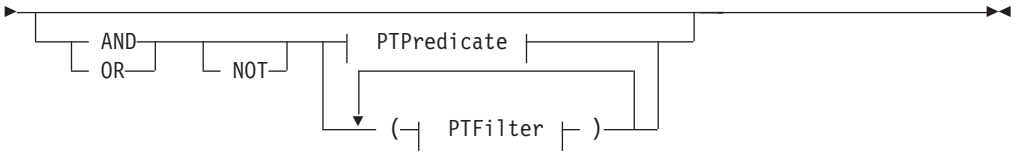
A filter on process templates is specified as a character string containing a filter predicate:

Notes:

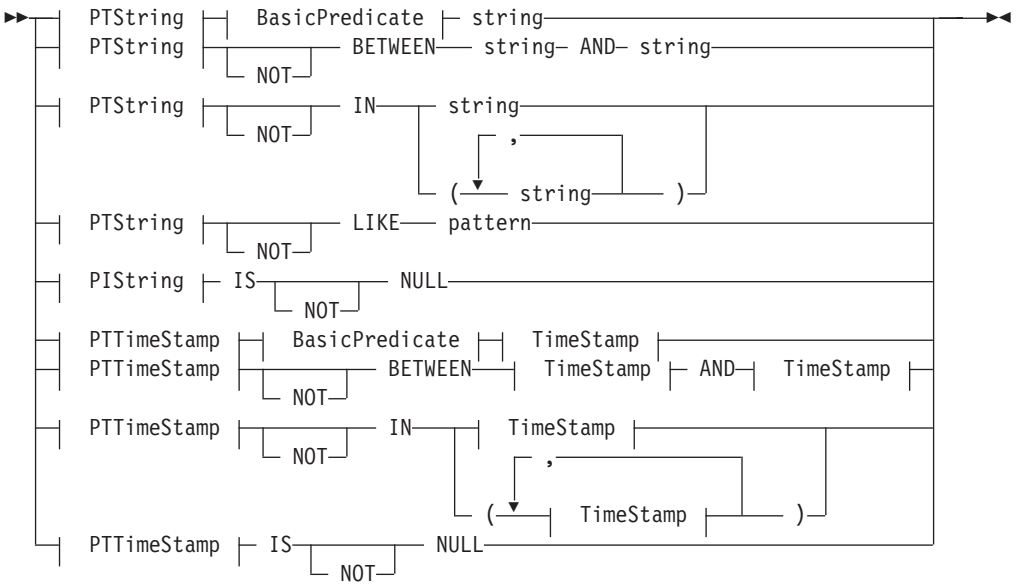
1. A *string* constant is to be enclosed in single quotes (').

   A *pattern* is a string constant in which the asterisk and the question mark have special meanings.
   - The question mark (?) represents any single character.
   - The asterisk (*) represents a string of zero or more characters.
   - The escape character is backslash (\) and must be used when the pattern itself contains actual question marks or asterisks.
2. Optional specifications in the *TimeStamp* are set to 0 (zero) if not specified.
3. When using filters in API calls, be aware that due to the different order of special characters, numbers, uppercase letters, and lowercase letters, in ASCII and EBCDIC, calls like QueryProcessTemplates() can return different results on OS/390 compare to LAN servers.

PTFilter



PTPredicate

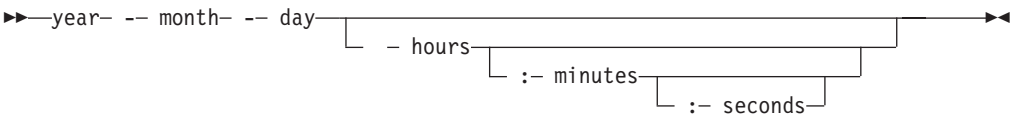


BasicPredicate

PTString

PTTimeStamp

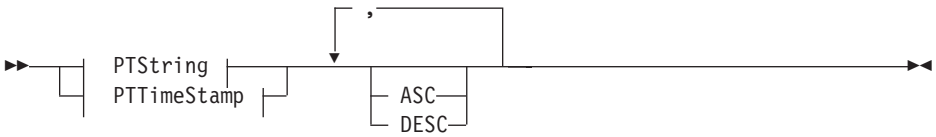
TimeStamp



Process templates can be sorted. A process template sort criterion is specified as a character string.

Note: The default sort order is ascending.

PTOrderBy



The number of process templates to be retrieved can be restricted via a threshold which specifies the maximum number of process templates to be returned to the client. That threshold is applied after the process templates have been sorted according to the sort criteria specified. Note that the process templates are sorted on the server, that is, the code page of the server determines the sort sequence.

The primary information that is retrieved for each process template is:
- Category
- CreationTime
- Description
- Icon
- InContainerNeeded
- LastModificationTime
- Name

Usage notes
- See “Action API calls” on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjExecutionServiceQueryProcessTemplates(
       FmcjExecutionServiceHandle       service,
       char const *                     filter,
       char const *                     sortCriteria,
       unsigned long const *            threshold,
       FmcjProcessTemplateVectorHandle * templates )
```

C++

```
APIRET QueryProcessTemplates(
       string const *                filter,
       string const *                sortCriteria,
       unsigned long const *         threshold,
       vector<FmcjProcessTemplate> &  templates ) const
```

Java

```
public abstract
ProcessTemplates[] queryProcessTemplates(
       String                        filter,
       String                        sortCriteria,
       Integer                       threshold   ) throws FmcException
```

COBOL

```
        FmcjESQueryProcTempls.

           CALL    "FmcjExecutionServiceQueryProcessTemplates"
                          USING
                          BY VALUE
                             serviceValue
                             filter
                             sortCriteria
                             threshold
                          BY REFERENCE
                             templates
                          RETURNING
                             intReturnValue.
```

Parameters

filter Input. The filter criteria which characterize the process templates to be retrieved.

service Input. A handle to the service object representing the session with the execution server.

sortCriteria Input. The sort criteria to be applied to the process templates found.

templates Input/Output. The qualifying vector of process templates.

threshold Input. The threshold which defines the maximum number of process templates to be returned to the client.

Return type

APIRET
The return code from this API call - see return codes below.
ProcessTemplate[]
The qualifying process templates.

Return codes/ FmcException
FMC_OK(0) The API call completed successfully.
FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.
FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_INVALID_FILTER(125)
The specified filter is not applicable to process templates.
FMC_ERROR_INVALID_SORT(808)
The specified sort criteria are not applicable to process templates.
FMC_ERROR_INVALID_THRESHOLD(807)
The specified threshold is invalid.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_QRY_RESULT_TOO_LARGE(817)
The number of process templates to be returned exceeds the maximum size allowed for query results - see the MAXIMUM_QUERY_MESSAGE_SIZE definition in your system, system group, or domain.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples
- For a C example, see "Query process instances (C)" on page 550.
- For a C++ example, see "Query process instances (C++)" on page 552.
- For a Java example, see "Query process instances (Java)" on page 553.
- For a COBOL example, see "Query process instances (COBOL)" on page 556.

QueryWorkitems()

This API call retrieves the work items the user has access to from the MQSeries Workflow execution server (action call).

In C, C++, and COBOL, any work items retrieved are appended to the supplied vector. If you want to read the current work items only, you have to clear the vector before you issue this API call. This means that you should set the vector handle to 0 in C or erase all elements of the vector in the C++ API.

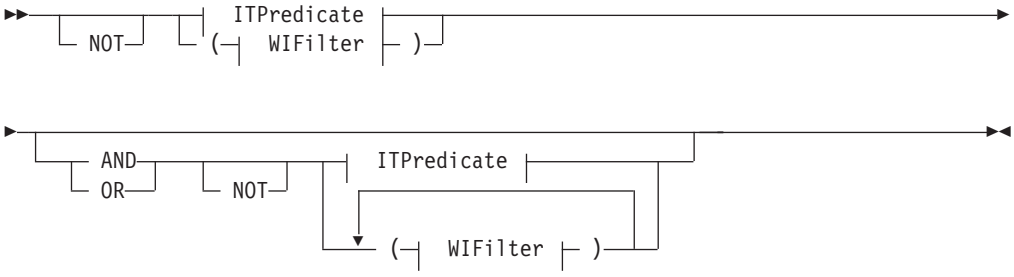
The work items to be retrieved can be characterized by a filter. A work item filter is specified as a character string:

Notes:

1. A *string* constant is to be enclosed in single quotes (').

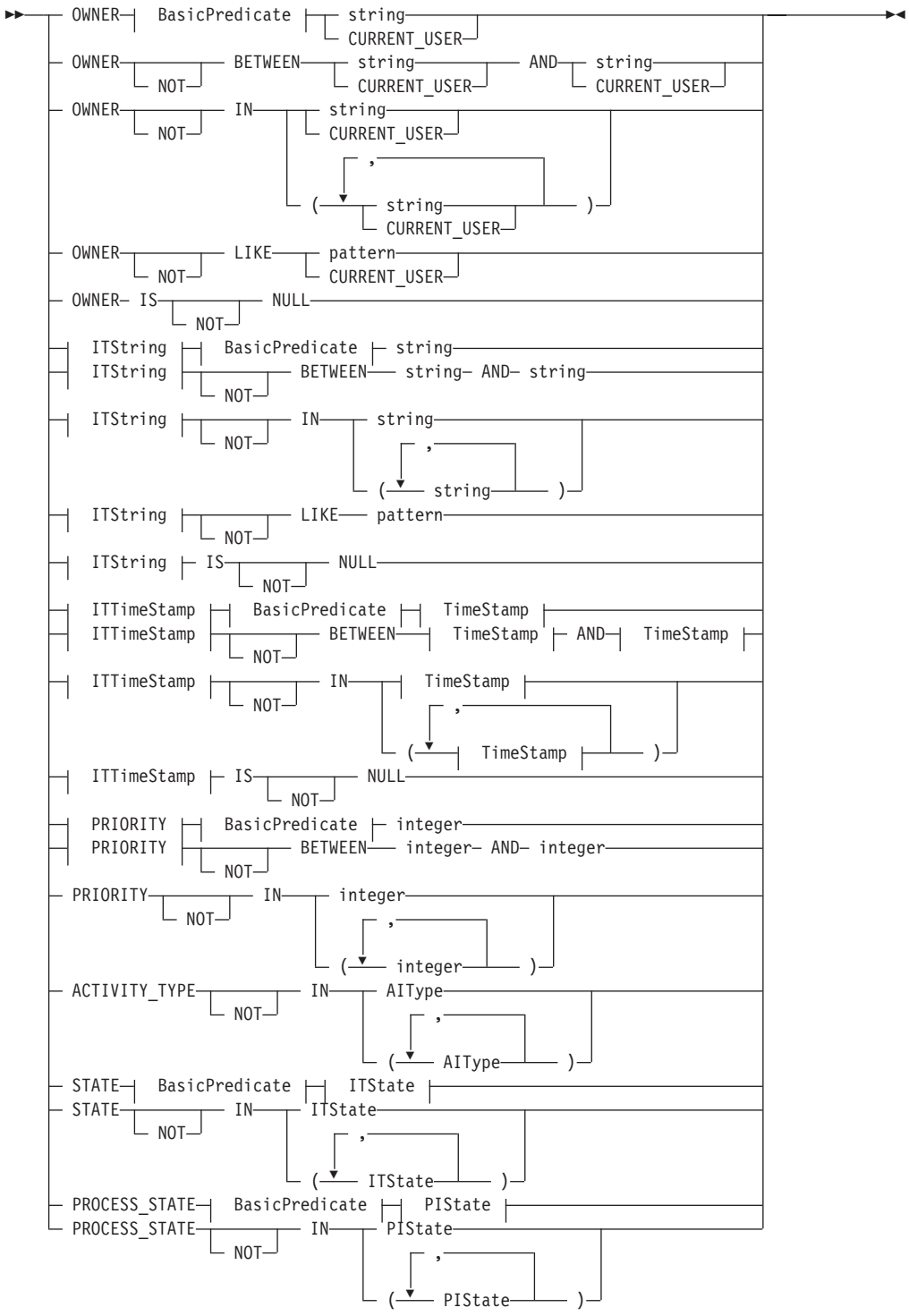
   A *pattern* is a string constant in which the asterisk and the question mark have special meanings.
   - The question mark (?) represents any single character.
   - The asterisk (*) represents a string of zero or more characters.
   - The escape character is backslash (\) and must be used when the pattern itself contains actual question marks or asterisks.
2. Optional specifications in the *TimeStamp* are set to 0 (zero) if not specified.

WIFilter



ITPredicate

ExecutionService



AIType

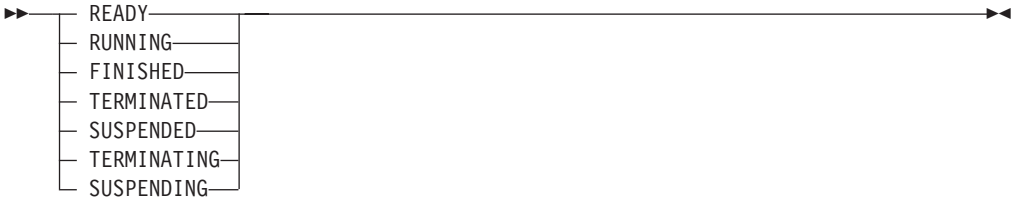
BasicPredicate

ITState

ITString

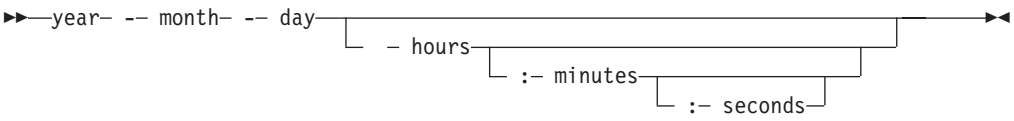
ITTimeStamp

PIState



ExecutionService

TimeStamp



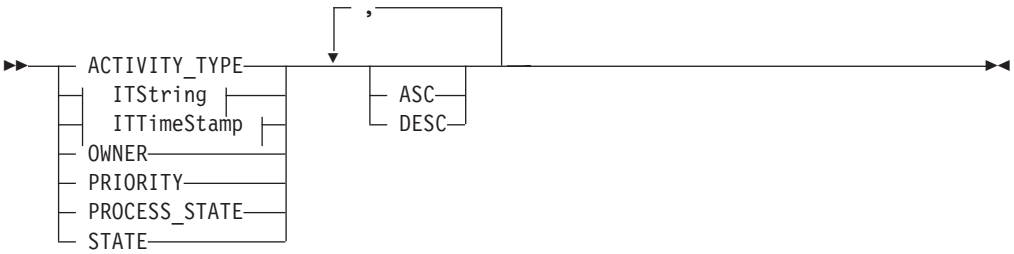
Work items can be sorted. A work item sort criterion is specified as a character string.

Note: The default sort order is ascending.

Activity types are sorted according to the sequence shown in the AIType diagram.

States are sorted according to the sequence shown in the ITState or the PIState diagram.

WIOrderBy



The number of work items to be retrieved can be restricted via a threshold which specifies the maximum number of work items to be returned to the client. That threshold is applied after the items have been sorted according to the sort criteria specified. Note that the items are sorted on the server, that is, the code page of the server determines the sort sequence.

The primary information that is retrieved for each work item is:
- ActivityType
- Category
- CreationTime
- Description
- Icon
- Implementation
- Kind
- LastModificationTime
- Name
- Owner
- Priority
- ProcessInstanceName
- ReceivedAs
- ReceivedTime
- StartTime
- State

- SupportTools

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjExecutionServiceQueryWorkitems(
       FmcjExecutionServiceHandle  service,
       char const *                filter,
       char const *                sortCriteria,
       unsigned long const *       threshold,
       FmcjWorkitemHandle *        workitems )
```

C++

```
APIRET QueryWorkitems(
       string const *               filter,
       string const *               sortCriteria,
       unsigned long const *        threshold,
       vector<FmcjWorkitem> &       workitems ) const
```

Java

```
public abstract
WorkItem[] queryWorkItems(
       String                        filter,
       String                        sortCriteria,
       Integer                       threshold   ) throws FmcException
```

COBOL

```
FmcjESQueryWorkitems.

   CALL    "FmcjExecutionServiceQueryWorkitems"
                  USING
                  BY VALUE
                     serviceValue
                     filter
                     sortCriteria
                     threshold
                  BY REFERENCE
                     workitems
                  RETURNING
                     intReturnValue.
```

Parameters

filter Input. The filter criteria which characterize the work items to be retrieved.

service Input. A handle to the service object representing the session with the execution server.

sortCriteria Input. The sort criteria to be applied to the work items found.

threshold Input. The threshold which defines the maximum number of work items to be returned to the client.

workitems Input/Output. The qualifying vector of work items.

Return type

APIRET The return code from this API call - see return codes below.

WorkItem[] The qualifying work items.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_INVALID_FILTER(125)
The specified filter is not applicable to work items.

FMC_ERROR_INVALID_SORT(808)
The specified sort criteria are not applicable to work items.

FMC_ERROR_INVALID_THRESHOLD(807)
The specified threshold is invalid.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_QRY_RESULT_TOO_LARGE(817)
The number of work items to be returned exceeds the maximum size allowed for query results - see the MAXIMUM_QUERY_MESSAGE_SIZE definition in your system, system group, or domain.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples
- For a C example, see "Query process instances (C)" on page 550.
- For a C++ example, see "Query process instances (C++)" on page 552.
- For a Java example, see "Query process instances (Java)" on page 553.
- For a COBOL example, see "Query process instances (COBOL)" on page 556.

QueryWorklists()

This API call retrieves the worklists the user has access to from the MQSeries Workflow execution server (action call).

In C, C++, and COBOL, any worklists retrieved are appended to the supplied vector. If you want to read the current worklists only, you have to clear the vector before you issue this API call. This means that you should set the vector handle to 0 in C or COBOL, or erase all elements of the vector in the C++ API.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjExecutionServiceQueryWorklists(
       FmcjExecutionServiceHandle  service,
       FmcjWorklistVectorHandle *  lists )
```

C++

```
APIRET QueryWorklists( vector<FmcjWorklist> & lists ) const
```

Java

```
public abstract
WorkList[] queryWorkLists()  throws FmcException
```

COBOL

```
         FmcjESQueryWorklists.

            CALL    "FmcjExecutionServiceQueryWorklists"
                           USING
                           BY VALUE
                              serviceValue
                           BY REFERENCE
                              lists
                           RETURNING
                              intReturnValue.
```

Parameters

lists Input/Output. The vector of worklists.

service Input. A handle to the service object representing the session with the execution server.

Return type

long/ APIRET The return code from this API call - see return codes below.

WorkList[] The qualifying worklists.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_QRY_RESULT_TOO_LARGE(817)
The number of worklists to be returned exceeds the maximum size allowed for query results - see the MAXIMUM_QUERY_MESSAGE_SIZE definition in your system, system group, or domain.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples

- For a C example, see "Query worklists (C)" on page 536.
- For a C++ example, see "Query worklists (C++)" on page 538.
- For a Java example, see "Query worklists (Java)" on page 539.
- For a COBOL example, see "Query worklists (COBOL)" on page 542.

Receive()

This API call allows for receiving data pushed by an MQSeries Workflow execution server or for receiving a response on an asynchronous request.

A correlation ID can be used to receive a specific response. To receive any data sent, it must be a 0 (NULL) pointer or specify FMCJ_NO_CORRELID. Note that the correlation ID is set on return provided that no 0 pointer is passed. This means that it has to be reset for each request.

The timeout value specifies how long the application should wait at a maximum for some data to arrive. If no data arrives, a timeout error is indicated. A timeout value of -1 indicates an indefinite wait time.

If data is successfully received, the execution data contains the data sent and can be used for updating objects or for creating new objects. See "ExecutionData" on page 247 for API calls supported by the execution data object.

The following enumeration types can be used to determine the contents of the execution data received:

C FmcjExecutionDataKindEnum

C++ FmcjExecutionData::KindEnum

Java Not supported

The enumeration constants can take the following values; it is strongly advised to use the symbolic names instead of the associated integer values.

NotSet(0) Indicates that nothing is known about the content of the execution data.

- **C** Fmc_DART_NotSet
- **C++** FmcjExecutionData::NotSet
- **COBOL** Fmc-DART-NotSet

Terminate(2) Indicates that receiving data can end.

- **C** Fmc_DART_Terminate
- **C++** FmcjExecutionData::Terminate
- **COBOL** Fmc-DART-Terminate

ItemDeleted(1000)
Indicates that a work item, an activity instance notification, or a process instance notification has been deleted.

- **C** Fmc_DART_ItemDeleted
- **C++** FmcjExecutionData::ItemDeleted
- **COBOL** Fmc-DART-ItemDeleted

Workitem(1002)
Indicates that a work item has been created or updated.

- **C** Fmc_DART_Workitem

C++ FmcjExecutionData::Workitem

COBOL Fmc-DART-Workitem

ActivityInstanceNotification(1003)
Indicates that an activity instance notification has been created or updated.

C Fmc_DART_ActivityInstanceNotification

C++ FmcjExecutionData::ActivityInstanceNotification

COBOL Fmc-DART-ActInstNotif

ProcessInstanceNotification(1004)
Indicates that a process instance notification has been created or updated.

C Fmc_DART_ProcessInstanceNotification

C++ FmcjExecutionData::ProcessInstanceNotification

COBOL Fmc-DART-ProcInstNotif

ExecuteInstanceResponse(1100)
Indicates that the execution data contains the response on an ExecuteProcessInstance() request.

C Fmc_DART_ExecuteInstanceResponse

C++ FmcjExecutionData::ExecuteInstanceResponse

COBOL Fmc-DART-ExecuteInstResponse

ExecuteProgramResponse(1101)
Indicates that the execution data contains the response to an ExecuteProgram() request.

C Fmc_DART_ExecuteProgramResponse

C++ FmcjExecutionData::ExecuteProgramResponse

COBOL Fmc-DART-ExecuteProgResponse

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server (present session mode)

API interface declarations

C fmcjcrun.h

C++ fmcjprun.hxx

Java not supported

C

```
APIRET FMC_APIENTRY FmcjExecutionServiceReceive(
       FmcjExecutionServiceHandle   service,
       FmcjCorrelID *               correlID,
       FmcjExecutionDataHandle *    data,
       signed long                  timeout )
```

C++

```
APIRET Receive( FmcjCorrelID *      correlID,
                FmcjExecutionData & data,
                signed long         timeout  ) const
```

COBOL

```
         FmcjESReceive.

            CALL    "FmcjExecutionServiceReceive"
                           USING
                           BY VALUE
                              serviceValue
                           BY REFERENCE
                              correlID
                              data
                           BY VALUE
                              timeoutValue
                           RETURNING
                              intReturnValue.
```

Parameters

correlID Input/Output. The correlation ID by which this data can be correlated to a previous request. Must be a NULL (0) pointer or point to Fmcj_No_CorrelID if you want to receive any data.

data Output. The data sent by an MQSeries Workflow execution server.

service Input. A handle to the service object representing the present session with the execution server.

timeout Input. The maximum time period in milliseconds to wait for some data to arrive.

Return type

APIRET The return code from this API call - see return codes below.

Return codes

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_MESSAGE_DATA(104)
The client received an unknown message.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

RemotePassthrough()

This API call can be used by an application program to establish a user session with an MQSeries Workflow execution server from within this program (activity implementation call).

When the activity implementation decides to distribute work among other programs and starts those programs as separate operating system processes, then those processes must be passed the CICS COMMAREA or IMS I/O Area in order to retrieve the information needed.

When successfully executed, a session is set up to the same execution server from which the original work item was started; the user on whose behalf the session is set up is the same one on whose behalf the original work item was started.

Note: This call will fail after the COMMAREA or I/O Area has been changed using SetOutContainer() or SetRemoteContainer().

Usage notes
- See "Activity implementation API calls" on page 122 for general information.

Authorization

Valid program identification

Required connection

None, but MQSeries Workflow program execution server must be active.

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjExecutionServiceRemotePassthrough(
       FmcjExecutionServiceHandle  service )
       char const *                programID )
```

C++

```
APIRET RemotePassthrough( string const & programID )
```

Java

```
public abstract
void remotePassthrough( String programID ) throws FmcException
```

COBOL

```
        FmcjESRemotePassthrough.

           CALL    "FmcjExecutionServiceRemotePassthrough"
                          USING
                          BY VALUE
                             serviceValue
                          BY REFERENCE
                             programID
                          RETURNING
                             intReturnValue.
```

Parameters

programID Input. The program identification by which the actually started activity implementation is known to the program execution server.

service Input. A handle to the service object representing the session to be established with the execution server.

Return type

long/ APIRET The return code from this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_INVALID_PROGRAMID(135)
The program identification is invalid.

FMC_ERROR_PROGRAM_EXECUTION(126)
Passthrough was not called from a program started by an activity implementation, or the program execution server is not active.

FMC_ERROR_TOOL_FUNCTION(128)
Passthrough cannot be called from a program started by the program execution server.

FMC_ERROR_USERID_UNKNOWN(10)
The user who started the work item no longer exists.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

TerminateReceive()

This API call causes information to be placed into the client input queue to tell that receiving data from an MQSeries Workflow execution server can end.

In this way, the receiving part of the application gets to know that receiving data can end. Any resulting actions are up to the application.

When the correlID parameter points to some buffer initialized to FMCJ_NO_CORRELID, then a correlation ID is returned which can be used to explicitly receive this data.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

None

Required connection

None

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	not supported

C

```
APIRET FMC_APIENTRY FmcjExecutionServiceTerminateReceive(
       FmcjExecutionServiceHandle  service,
       FmcjCorrelID *              correlID )
```

C++

```
APIRET TerminateReceive( FmcjCorrelID * correlID = 0 )
```

COBOL

```
FmcjESTerminateReceive.

   CALL    "FmcjExecutionServiceTerminateReceive"
                  USING
                  BY VALUE
                     serviceValue
                  BY REFERENCE
                     correlID
                  RETURNING
                     intReturnValue.
```

Parameters

correlID Input/Output. The correlation ID by which this request can be correlated.

service Input. A handle to the service object.

Return type

APIRET The return code from this API call - see return codes below.

Return codes

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_INVALID_CORRELATION_ID(506)
The correlation ID passed is not FMCJ_NO_CORRELID.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Item actions

An Item object represents a work item or an activity instance notification or a process instance notification.

An FmcjItem or Item object represents the common aspects of work items and notifications. In C++, FmcjItem is thus the superclass of the FmcjWorkitem, FmcjActivityInstanceNotification, and FmcjProcessInstanceNotification classes and provides for all common properties and methods. In Java, Item is thus a superclass of the WorkItem, ActivityInstanceNotification, and ProcessInstanceNotification

classes and provides for all common properties and methods. Similarly, in C or COBOL, common implementations of functions are taken from FmcjItem. That is, common functions start with the prefix FmcjItem; they are also defined starting with the prefixes FmcjWorkitem, FmcjActivityInstanceNotification, and FmcjProcessInstanceNotification.

An item is uniquely identified by its object identifier.

The following sections describe the actions which can be applied on an item. See "Item" on page 256 for a complete list of API calls.

Delete()

This API call deletes the specified item from the MQSeries Workflow execution server (action call).

A notification can always be deleted. A work item must be in states *Ready*, *Finished*, *ForceFinished*, or *Disabled*. If the work item is in the *Ready* state and represents the only work associated with the activity instance and when the associated process instance is not *Terminating* or *Terminated*, then deletion is rejected.

There are no impacts on the transient representation of your item; in C and C++, you have to destruct or deallocate the transient object when it is no longer needed.

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

Be the item owner

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.Item
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjItemDelete( FmcjItemHandle hdlItem )

#define FmcjActivityInstanceNotificationDelete FmcjItemDelete
#define FmcjProcessInstanceNotificationDelete  FmcjItemDelete
#define FmcjWorkitemDelete                     FmcjItemDelete
```

C++

```
APIRET Delete()
```

Java

```
public abstract
void   delete() throws FmcException
```

COBOL

```
        FmcjItemDelete.

           CALL    "FmcjItemDelete"
                          USING
                          BY VALUE
                             hdlItem
                          RETURNING
                             intReturnValue.
```

Parameters

hdlItem Input. The handle of the item to be deleted.

Return type

long/ APIRET The return code from this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The item no longer exists.

FMC_ERROR_NOT_ALLOWED(507)
The item represents the only work associated with the activity instance.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_WRONG_STATE(120)
The item is in the wrong state.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

ObtainProcessInstanceMonitor()

This API call retrieves the process instance monitor for the process instance the item is part of from the MQSeries Workflow execution server (action call).

When the *deep* option is specified, then activity instances of type Block are resolved, that is, their block instance monitors are also fetched from the server.

Note: *Deep* is not yet supported.

In C++, when the process instance monitor object to be initialized is not empty, that object is destructed before the new one is assigned. In C, the application is completely responsible for the ownership of objects, that is, it is not checked whether the process instance monitor handle already points to some object.

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

One of:

- Process authorization
- Process administration authorization
- Be the process administrator
- Be the process creator
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.Item
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjItemObtainProcessInstanceMonitor(
       FmcjItemHandle                      hdlItem,
       bool                                deep,
       FmcjProcessInstanceMonitorHandle *  monitor)

#define FmcjActivityInstanceNotificationObtainProcessInstanceMonitor
        FmcjItemObtainProcessInstanceMonitor
#define FmcjProcessInstanceNotificationObtainProcessInstanceMonitor
        FmcjItemObtainProcessInstanceMonitor
#define FmcjWorkitem
        FmcjItemObtainProcessInstanceMonitor
```

C++

```
APIRET ObtainProcessInstanceMonitor(
       FmcjProcessInstanceMonitor &    monitor,
       bool                            deep= false ) const
```

Java

```
public abstract
ProcessInstanceMonitor obtainProcessInstanceMonitor(
                       boolean deep ) throws FmcException
```

COBOL

```
         FmcjItemObtainProcInstMon.

            CALL    "FmcjItemObtainProcessInstanceMonitor"
                           USING
                           BY VALUE
                              hdlItem
                              deep
                           BY REFERENCE
                              monitor
                           RETURNING
                              intReturnValue.
```

Parameters

deep Input. An indicator whether activity instances of type Block are to be resolved, that is, their monitor is also to be provided. Note, deep is not yet supported.

hdlItem Input. The item whose process instance monitor is to be retrieved.

monitor Input/Output. The address of the handle to the process instance monitor or the process instance monitor object to be set.

returnCode Input/Output. The return code of calling this method - see return codes below.

Return type

APIRET The return code from this API call - see return codes below.

ProcessInstanceMonitor*/ ProcessInstanceMonitor
A pointer to the process instance monitor or the process instance monitor the item is a part of.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The item no longer exists.
FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

ProcessInstance()

This API call retrieves the process instance the item is a part of from the MQSeries Workflow execution server (action call).

All information about the process instance, primary and secondary, is retrieved.

In C++, when the process instance object to be initialized is not empty, that object is destructed before the new one is assigned. In C, the application is completely responsible for the ownership of objects, that is, it is not checked whether the process instance handle already points to some object.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Process authorization
- Process administration authorization
- Be the process creator
- Be the process administrator
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.Item
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjItemProcessInstance(
       FmcjItemHandle              hdlItem,
       FmcjProcessInstanceHandle *  instance )

#define FmcjActivityInstanceNotificationProcessInstance
        FmcjItemProcessInstance
#define FmcjProcessInstanceNotificationProcessInstance
        FmcjItemProcessInstance
#define FmcjWorkitemProcessInstance
        FmcjItemProcessInstance
```

C++

```
APIRET ProcessInstance( FmcjProcessInstance & instance ) const
```

Java

```
public abstract
ProcessInstance processInstance() throws FmcException
```

COBOL

```
         FmcjItemProcInst.

            CALL    "FmcjItemProcessInstance"
                           USING
                           BY VALUE
                              hdlItem
                           BY REFERENCE
                              instance
                           RETURNING
                              intReturnValue.
```

Parameters

hdlItem Input. The handle of the item object to be queried.

instance Input/Output. The process instance object to be retrieved (initialized).

returnCode Input/Output. The return code of calling this method - see return codes below.

Return type

APIRET The return code from this API call - see return codes below.

ProcessInstance*/ ProcessInstance

A pointer to the process instance or the process instance the item is a part of.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)

A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The item no longer exists.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Refresh()

This API call refreshes the item from the MQSeries Workflow execution server (action call).

All information about the item, primary and secondary, is retrieved.

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

One of:

- Be the item owner
- Work item authorization
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.Item
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjItemRefresh( FmcjItemHandle hdlItem )

#define FmcjActivityInstanceNotificationRefresh FmcjItemRefresh
#define FmcjProcessInstanceNotificationRefresh  FmcjItemRefresh
#define FmcjWorkitemRefresh                     FmcjItemRefresh
```

C++

```
APIRET Refresh()
```

Java

```
public abstract
void   refresh() throws FmcException
```

COBOL

```
         FmcjItemRefresh.

            CALL    "FmcjItemRefresh"
                           USING
                           BY VALUE
                              hdlItem
                           RETURNING
                              intReturnValue.
```

Parameters

hdlItem Input. The handle of the item object to be refreshed.

Return type

long/ APIRET The return code from this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The item no longer exists.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

SetDescription()

This API call sets the description of the item to the specified value (action call).

If no description is provided, the description of the item is reset to the description of the associated activity instance or process instance.

The following rules apply for specifying an item description:

- You can specify a maximum of 254 characters.
- You can use any printable characters depending on your current locale, including the end-of-line and new-line characters.

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

Be the item owner

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.Item
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjItemSetDescription(
                            FmcjItemHandle  hdlItem,
                            char const *    description )

#define FmcjActivityInstanceNotificationSetDescription
        FmcjItemSetDescription
#define FmcjProcessInstanceNotificationSetDescription
        FmcjItemSetDescription
#define FmcjWorkitemSetDescription
        FmcjItemSetDescription
```

C++

```
APIRET SetDescription( string const * description )
```

Java

```
public abstract
void   setDescription( String description ) throws FmcException
```

COBOL

```
        FmcjItemSetDescription.

           CALL    "FmcjItemSetDescription"
                          USING
                          BY VALUE
                             hdlItem
                             description
                          RETURNING
                             intReturnValue.
```

Parameters

description Input. The description or a pointer to the description to be set; can be a NULL (0) pointer or null object (Java).

hdlItem Input. The handle of the item object whose description is to be set.

Return type

long/ APIRET The return code from this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The item no longer exists.

FMC_ERROR_INVALID_DESCRIPTION(810)
The description does not conform to the syntax rules.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

SetName()

This API call sets the name of the item (action call).

If no name is provided, the name of the item is reset to its default, the activity instance or the process instance name.

The following rules apply for specifying a work item or activity instance notification name:

- You can specify a maximum of 32 characters.
- You can use any printable characters depending on your current locale, except the following:
  `! " ' ( ) * + , - . / : ; < = > [ \ ] ^`
- You can use blanks with these restrictions: no leading blanks, no trailing blanks, and no consecutive blanks.
- You cannot use leading digits.
- You cannot use keywords AND, OR, NOT, IS, NULL, MOD, LOWER, UPPER, VALUE, SUBSTR, _BLOCK

The following rules apply for specifying a process instance notification name:

- You can specify a maximum of 63 characters.
- You can use any printable characters depending on your current locale, except the following:
  `* ? " ; : . $`
- You can use blanks with these restrictions: no leading blanks, no trailing blanks, and no consecutive blanks.

Usage notes

- See “Action API calls” on page 122 for general information.

Authorization

Be the item owner

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.Item
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjItemSetName( FmcjItemHandle  hdlItem,
                                     char const *    name )

#define FmcjActivityInstanceNotificationSetName FmcjItemSetName
#define FmcjProcessInstanceNotificationSetName  FmcjItemSetName
#define FmcjWorkitemSetName                     FmcjItemSetName
```

C++

```
APIRET SetName( string const * name )
```

Java

```
public abstract
void   setName( String name ) throws FmcException
```

COBOL

```
        FmcjItemSetName.

           CALL    "FmcjItemSetName"
                          USING
                          BY VALUE
                             hdlItem
                             name
                          RETURNING
                             intReturnValue.
```

Parameters

hdlItem Input. The handle of the item to be dealt with.

name Input. The new name of the item; can be a NULL (0) pointer or null object (Java).

Return type

long/ APIRET The return code from this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The item no longer exists.

FMC_ERROR_INVALID_NAME(134)
The name does not conform to the syntax rules.
FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Transfer()

This API call transfers an item to the specified user (action call).

Notifications can always be transferred. A work item must be in states *Ready*, *InError*, *Executed*, *Suspending*, or *Suspended* and the associated process instance in states *Running*, *Suspending*, or *Suspended*.

The user who transfers the item must be the owner of the item or have work item authorization for the owner of the item and have work item authorization for the new owner.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Workitem authority for the persons to transfer from/to
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.Item
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjItemTransfer( FmcjItemHandle hdlItem,
                                      char const *   userID )

#define FmcjActivityInstanceNotificationTransfer FmcjItemTransfer
#define FmcjProcessInstanceNotificationTransfer  FmcjItemTransfer
#define FmcjWorkitemTransfer                     FmcjItemTransfer
```

C++

```
APIRET Transfer( string const & userID )
```

Java

```
public abstract
void   transfer( String userID ) throws FmcException
```

COBOL

```
        FmcjItemTransfer.

           CALL    "FmcjItemTransfer"
                          USING
                          BY VALUE
                             hdlItem
                             userID
                          RETURNING
                             intReturnValue.
```

Parameters

hdlItem Input. The handle of the item object to be transferred.

userID Input. The ID of the user to whom the item is to be transferred.

Return type

long/ APIRET The return code from this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The item no longer exists.

Item

FMC_ERROR_NEW_OWNER_ABSENT(110)
The user to whom the item is to be transferred is absent, that is, the item is not transferred.

FMC_ERROR_NEW_OWNER_NOT_FOUND(107)
The user to whom the item is to be transferred is unknown.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_OWNER_ALREADY_ASSIGNED(133)
The user to whom the item is to be transferred does already have that item.

FMC_ERROR_WRONG_STATE(120)
The item or process instance is in the wrong state.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

PersistentList actions

A PersistentList object represents a set of objects of the same type the user is authorized for. Moreover, all objects which are accessible through this list have the same characteristics. These characteristics are specified by a filter. Additionally, sort criteria can be applied and, after that, a threshold to restrict the number of objects to be transferred from a server to the client.

As the name indicates, the list definition is stored persistently. The objects contained in the list are, however, assembled dynamically when they are queried.

A persistent list can be a process template list, a process instance list, or a worklist.

An FmcjPersistentList or PersistentList object represents the common aspects of lists. In C++, FmcjPersistentList is thus the superclass of the FmcjProcessInstanceList, FmcjProcessTemplateList, and FmcjWorklist classes and provides for all common properties and methods. In Java, PersistentList is thus a superclass of the ProcessInstanceList, ProcessTemplateList, and Worklist classes and provides for all common properties and methods. Similarly, in C or COBOL, common implementations of functions are taken from FmcjPersistentList. That is, common functions start with the prefix FmcjPersistentList; they are also defined starting with the prefixes FmcjProcessInstanceList, FmcjProcessTemplateList, and FmcjWorklist.

A persistent list is uniquely identified by its name, type, and owner. It can be defined for general access purposes; it is then of a *public* type. Or, it can be defined for some specific user; it is then of a *private* type.

The following sections describe the actions which can be applied on a persistent list. See “PersistentList” on page 259 for a complete list of API calls.

Delete()

This API call deletes the specified persistent list from the MQSeries Workflow execution server (action call).

The transient representation of the persistent list is not impacted; in C, C++, and COBOL, you have to destruct or deallocate the transient object when it is no longer needed.

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

One of:

- Be the owner of the list
- Staff definition
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.PersistentList
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjPersistentListDelete( FmcjPersistentListHandle hdlList )

#define FmcjProcessInstanceListDelete FmcjPersistentListDelete
#define FmcjProcessTemplateListDelete FmcjPersistentListDelete
#define FmcjWorklistDelete            FmcjPersistentListDelete
```

C++

```
APIRET Delete()
```

Java

```
public abstract
void   delete() throws FmcException
```

COBOL

```
FmcjPLDelete.

   CALL    "FmcjPersistentListDelete"
                  USING
                  BY VALUE
                     hdlList
                  RETURNING
                     intReturnValue.
```

Parameters

hdlList Input. The handle of the persistent list to be deleted.

Return type

long/ APIRET The return code from this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_DOES_NOT_EXIST(118)
The persistent list no longer exists.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Refresh()

This API call refreshes the persistent list from the MQSeries Workflow execution server (action call).

All information about the persistent list is retrieved, for example, its description, its filter, or its sort criteria.

Usage notes

- See “Action API calls” on page 122 for general information.

Authorization

One of:
- Be the owner of the list
- Staff definition
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.PersistentList
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjPersistentListRefresh( FmcjPersistentListHandle hdlList )

#define FmcjProcessInstanceListRefresh FmcjPersistentListRefresh
#define FmcjProcessTemplateListRefresh FmcjPersistentListRefresh
#define FmcjWorklistRefresh            FmcjPersistentListRefresh
```

C++

```
APIRET Refresh()
```

Java

```
public abstract
void   refresh() throws FmcException
```

COBOL

```
        FmcjPLRefresh.

           CALL    "FmcjPersistentListRefresh"
                          USING
                          BY VALUE
                             hdlList
                          RETURNING
                             intReturnValue.
```

Parameters

hdlList Input. The handle of the persistent list to be refreshed.

Return type

long/ APIRET The return code from this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The persistent list no longer exists.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

SetDescription()

This API call sets the description of the persistent list to the specified value (action call).

If no description is provided, the description of the persistent list is erased.

The following rules apply for specifying a persistent list description:

- You can specify a maximum of 254 characters.
- You can use any printable characters depending on your current locale, including the end-of-line and new-line characters.

Usage notes

- See “Action API calls” on page 122 for general information.

Authorization

One of:

- Be the owner of the list
- Staff definition
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.PersistentList
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjPersistentListSetDescription( FmcjPersistentListHandle hdlList,
                                  char const *             description )

#define FmcjProcessInstanceListSetDescription
        FmcjPersistentListSetDescription
#define FmcjProcessTemplateListSetDescription
        FmcjPersistentListSetDescription
#define FmcjWorklistSetDescription
        FmcjPersistentListSetDescription
```

C++

```
APIRET SetDescription( string const * description )
```

Java

```
public abstract
void   setDescription( String description ) throws FmcException
```

COBOL

```
         FmcjPLSetDescription.

            CALL    "FmcjPersistentListSetDescription"
                          USING
                          BY VALUE
                             hdlList
                             description
                          RETURNING
                             intReturnValue.
```

Parameters

description Input. The description or a pointer to the description to be set; can be a NULL (0) pointer or null object (Java).

hdlList Input. The handle of the persistent list object whose description is to be set.

Return type

long/ APIRET The return code from this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The persistent list no longer exists.

FMC_ERROR_INVALID_DESCRIPTION(810)
The description does not conform to the syntax rules.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

SetFilter()

This API call sets the filter of the persistent list to the specified value (action call).

If no filter is provided, the current filter of the persistent list is erased. This means that all objects authorized for will be selected via this list.

Refer to the appropriate list creation for a description of a valid filter syntax.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Be the owner of the list
- Staff definition
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.PersistentList
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjPersistentListSetFilter( FmcjPersistentListHandle  hdlList,
                             char const *              filter )

#define FmcjProcessInstanceListSetFilter FmcjPersistentListSetFilter
#define FmcjProcessTemplateListSetFilter FmcjPersistentListSetFilter
#define FmcjWorklistSetFilter            FmcjPersistentListSetFilter
```

C++

```
APIRET SetFilter( string const * filter )
```

Java

```
public abstract
void   setFilter( String filter ) throws FmcException
```

COBOL

```
        FmcjPLSetFilter.

           CALL    "FmcjPersistentListSetFilter"
                         USING
                         BY VALUE
                            hdlList
                            filter
                         RETURNING
                            intReturnValue.
```

Parameters

filter Input. The filter or a pointer to the filter to be set; can be a NULL (0) pointer or null object (Java).

hdlList Input. The handle of the persistent list object whose filter is to be set.

Return type

long/ APIRET The return code from this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The persistent list no longer exists.
FMC_ERROR_INVALID_FILTER(125)
The specified filter is invalid.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

SetSortCriteria()

This API call sets the sort criteria of the persistent list to the specified value (action call).

If no sort criteria are provided, the current sort criteria of the persistent list are erased. This means that objects selected via this list will not be sorted.

Refer to the appropriate list creation for a description of a valid sort criteria syntax.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Be the owner of the list
- Staff definition
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.PersistentList
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjPersistentListSetSortCriteria( FmcjPersistentListHandle hdlList,
                                   char const *             sortCriteria )

#define FmcjProcessInstanceListSetSortCriteria
        FmcjPersistentListSetSortCriteria
#define FmcjProcessTemplateListSetSortCriteria
        FmcjPersistentListSetSortCriteria
#define FmcjWorklistSetSortCriteria
        FmcjPersistentListSetSortCriteria
```

C++

```
APIRET SetSortCriteria( string const * sortCriteria )
```

Java

```
public abstract
void   setSortCriteria( String sortCriteria ) throws FmcException
```

COBOL

```
        FmcjPLSetSortCriteria.

           CALL    "FmcjPersistentListSetSortCriteria"
                          USING
                          BY VALUE
                             hdlList
                             sortCriteria
                          RETURNING
                             intReturnValue.
```

Parameters

hdlList Input. The handle of the persistent list object whose sort criteria are to be set.

sortCriteria Input. The sort criteria or a pointer to the sort criteria to be set; can be a NULL (0) pointer or null object (Java).

Return type

long/ APIRET The return code from this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_DOES_NOT_EXIST(118)
The persistent list no longer exists.
FMC_ERROR_INVALID_SORT(808)
The specified sort criteria are invalid.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

SetThreshold()

This API call sets the threshold of the persistent list to the specified value (action call).

If no threshold is provided, the threshold of the persistent list is erased. This means that all objects contained in the list will be provided when queried.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Be the owner of the list
- Staff definition
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.PersistentList
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjPersistentListSetThreshold( FmcjPersistentListHandle hdlList,
                                unsigned long const *    threshold )

#define FmcjProcessInstanceListSetThreshold  FmcjPersistentListSetThreshold
#define FmcjProcessITemplateListSetThreshold FmcjPersistentListSetThreshold
#define FmcjWorklistSetThreshold             FmcjPersistentListSetThreshold
```

C++

```
APIRET SetThreshold( unsigned long const * threshold )
```

Java

```
public abstract
void   setThreshold( Integer threshold ) throws FmcException
```

COBOL

```
        FmcjPLSetThreshold.

           CALL    "FmcjPersistentListSetThreshold"
                         USING
                         BY VALUE
                            hdlList
                            threshold
                         RETURNING
                            intReturnValue.
```

Parameters

hdlList Input. The handle of the persistent list object whose threshold is to be set.

threshold Input. The threshold or a pointer to the threshold to be set; can be a NULL (0) pointer or null object (Java).

Return type

long/ APIRET The return code from this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The persistent list no longer exists.
FMC_ERROR_INVALID_THRESHOLD(807)
The threshold is invalid.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Person actions

An FmcjPerson or a Person object represents an MQSeries Workflow user. A person is uniquely identified by its user identification.

The following sections describe the actions which can be applied on a person. See "Person" on page 260 for a complete list of API calls.

Refresh()

This API call refreshes the person from the MQSeries Workflow execution server (action call).

All information about the person, primary and secondary, is retrieved.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.Person
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjPersonRefresh( FmcjPersonHandle hdlPerson )
```

C++

```
APIRET Refresh()
```

Java

```
public abstract
void   refresh() throws FmcException
```

COBOL

```
         FmcjPRefresh.

            CALL    "FmcjPersonRefresh"
                           USING
                           BY VALUE
                              hdlPerson
                           RETURNING
                              intReturnValue.
```

Parameters

hdlPerson Input. The handle of the person to be refreshed.

Return type

long/ APIRET The return code of calling this method - see below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

SetAbsence()

This API call sets the absence indication of the logged-on user to the specified value (action call).

When a person is absent, this person does not participate in staff resolution, that is, this person does not get assigned any work items.

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.Person
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjPersonSetAbsence(
       FmcjPersonHandle  hdlPerson,
       bool              newValue )
```

C++

```
APIRET SetAbsence( bool newValue )
```

Java

```
public abstract
void   setAbsence( boolean newValue ) throws FmcException
```

COBOL

```
         FmcjPSetAbsence.

            CALL    "FmcjPersonSetAbsence"
                          USING
                          BY VALUE
                             hdlPerson
                             newValue
                          RETURNING
                             intReturnValue.
```

Parameters

hdlPerson Input. The handle of the person object whose absence is to be set.
newValue Input. True, if the person is denoted as absent, else false.

Return type

long/ APIRET The return code of calling this method - see below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

SetSubstitute()

This API call sets the substitute of the logged-on user (action call).

The substitute must be a registered MQSeries Workflow user ID other than the logged-on user. If no substitute is provided, the substitute of the logged-on user is erased.

Usage notes

- See “Action API calls” on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server

API interface declarations

C fmcjcrun.h

C++ fmcjprun.hxx

Java com.ibm.workflow.api.Person

COBOL fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjPersonSetSubstitute(
                    FmcjPersonHandle  hdlPerson,
                    char const *      substitute )
```

C++

```
APIRET SetSubstitute( string const * substitute )
```

Java

```
public abstract
void   setSubstitute( String substitute ) throws FmcException
```

COBOL

```
         FmcjPSetSubstitute.

            CALL    "FmcjPersonSetSubstitute"
                           USING
                           BY VALUE
                              hdlPerson
                              substitute
                           RETURNING
                              intReturnValue.
```

Parameters

hdlPerson Input. The handle of the person object whose substitute is to be set.

substitute Input. The substitute or a pointer to the substitute to be set; can be a NULL (0) pointer or null object (Java).

Return type

long/ APIRET The return code of calling this method - see below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_INVALID_USER(132)
The specified user ID does not correspond to the syntax rules or the user cannot be logged on and be the substitute at the same time.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_USERID_UNKNOWN(10)
The specified user ID is not a registered MQSeries Workflow user ID.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

ProcessInstance actions

A ProcessInstance object represents an instance of a process template. A process instance is uniquely identified by its object identifier or by its name. Depending on the keep option when the process instance was created, the unique process instance name has been supplied by the user or has been generated by MQSeries Workflow.

The following diagram provides an overview of the possible process instance states and the actions which are allowed in those states, provided that the appropriate authority has been granted:

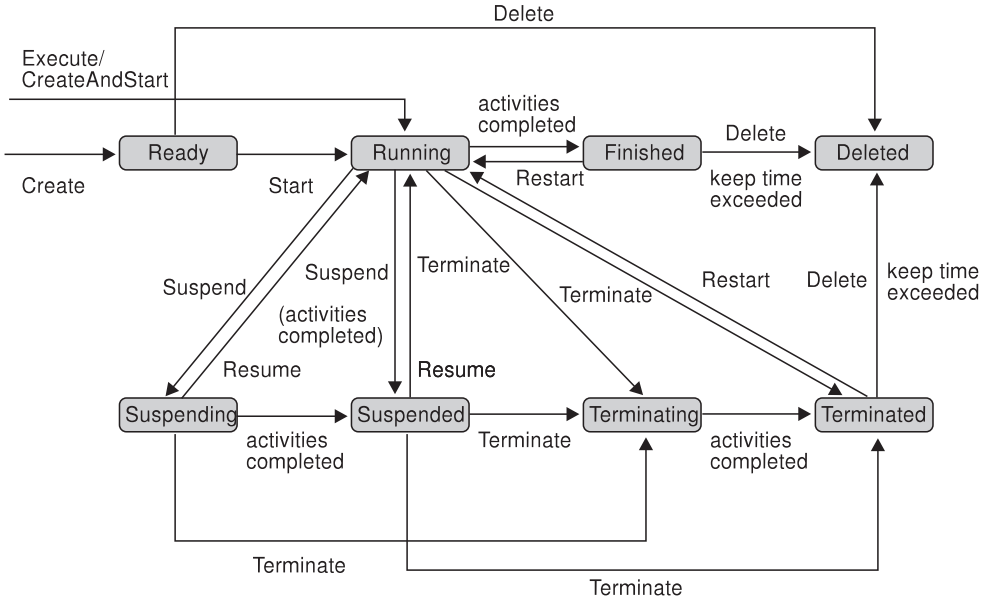


Figure 43. Process instance states

The following sections describe the actions which can be applied on a process instance. See “ProcessInstance” on page 265 for a complete list of API calls.

Delete()

This API call deletes the specified process instance from the MQSeries Workflow execution server (action call).

The process instance must be a top-level process and in states *Ready*, *Finished*, or *Terminated*. The creator can delete the process instance as long as it has not been started.

There are no impacts on your transient representation of the process instance; in C and C++, you have to destruct or deallocate the transient object when it is no longer needed.

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

One of:

- Process administration authorization
- Be the process instance creator
- Be the process administrator
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProcessInstance
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjProcessInstanceDelete( FmcjProcessInstanceHandle hdlInstance )
```

C++

```
APIRET Delete()
```

Java

```
public abstract
void   delete() throws FmcException
```

COBOL

```
FmcjPIDelete.

   CALL    "FmcjProcessInstanceDelete"
                  USING
                  BY VALUE
                     hdlInstance
                  RETURNING
                     intReturnValue.
```

Parameters
hdlInstance Input. The handle of the process instance to be deleted.

Return type
long/ APIRET The result of making this API call - see return codes below.

Return codes/ FmcException
FMC_OK(0) The API call completed successfully.
FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.
FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.
FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_DOES_NOT_EXIST(118)
The process instance no longer exists.
FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_WRONG_STATE(120)
The process instance is in the wrong state.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

InContainer()

This API call retrieves the input container associated with the process instance from the MQSeries Workflow execution server (action call).

In C++, when the container object to be initialized is not empty, that object is destructed before the new one is assigned. In C, the application is completely

responsible for the ownership of objects, that is, it is not checked whether the container handle already points to some object.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Process authorization
- Process administration authorization
- Be the process instance creator
- Be the process administrator
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProcessInstance
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjProcessInstanceInContainer(
       FmcjProcessInstanceHandle      hdlInstance,
       FmcjReadWriteContainerHandle * input )
```

C++

```
APIRET InContainer( FmcjReadWriteContainer & input )
```

Java

```
public abstract
ReadWriteContainer inContainer() throws FmcException
```

COBOL

```
FmcjPIInCtnr.

   CALL    "FmcjProcessInstanceInContainer"
                  USING
                  BY VALUE
                     hdlInstance
                  BY REFERENCE
                     inputValue
                  RETURNING
                     intReturnValue.
```

Parameters

hdlInstance Input. The handle of the process instance object whose input container is to be retrieved.

input Input/Output. The address of the input container or of its handle or the input container of the process instance to be set.

Return type

long/ APIRET The result of making this API call - see return codes below.

ReadWriteContainer
The input container of the process instance.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The process instance no longer exists.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

ObtainMonitor()

This API call obtains a monitor for the process instance from the MQSeries Workflow execution server (action call).

When the deep option is specified, then activity instances of type Block are resolved, that is, their block instance monitors are also fetched from the server.

Note: Deep is not yet supported.

In C++, when the process instance monitor object to be initialized is not empty, that object is destructed before the new one is assigned. In C, the application is completely responsible for the ownership of objects, that is, it is not checked whether the process instance monitor handle already points to some object.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Process authorization
- Process administration authorization
- Be the process instance creator
- Be the process administrator
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProcessInstance
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjProcessInstanceObtainMonitor(
       FmcjProcessInstanceHandle         hdlInstance,
       bool                              deep,
       FmcjProcessInstanceMonitorHandle * monitor )
```

C++

```
APIRET ObtainMonitor( FmcjProcessInstanceMonitor & monitor,
                      bool                         deep= false )
```

Java

```
public abstract
ProcessInstanceMonitor obtainMonitor( boolean deep ) throws FmcException
```

COBOL

```
        FmcjPIObtainMon.

           CALL    "FmcjProcessInstanceObtainMonitor"
                          USING
                          BY VALUE
                             hdlInstance
                             deep
                          BY REFERENCE
                             monitor
                          RETURNING
                             intReturnValue.
```

Parameters

deep Input. An indicator whether activity instances of type Block are to be resolved, that is, their monitor is also to be provided. Note, deep is not yet supported.

hdlInstance Input. The handle of the process instance object whose monitor is to be retrieved.

monitor Input/Output. The address of the monitor handle or the monitor of the process instance to be set.

returnCode Input/Output. A pointer to the result of the method call - see return codes below.

Return type

APIRET The return code from this API call - see return codes below.

InstanceMonitor*/ProcessInstanceMonitor

A pointer to the process instance monitor or the process instance monitor.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)

A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)

The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)

The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)

The process instance no longer exists.

FMC_ERROR_NOT_AUTHORIZED(119)

Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)

Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

PersistentObject()

This API call retrieves the process instance identified by the passed object identifier from the MQSeries Workflow execution server (action call).

The MQSeries Workflow execution server from which the process instance is to be retrieved is identified by the execution service object. The transient object is then created or updated with all information, primary and secondary, of the process instance.

In C++, when the process instance object to be initialized is not empty, that object is destructed before the new one is assigned. In C, the application is completely responsible for the ownership of objects, that is, it is not checked whether the process instance handle already points to some object. In Java, a process instance is newly created; the execution service acts as a factory.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Process authorization
- Process administration authorization
- Be the process instance creator
- Be the process administrator
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjProcessInstancePersistentObject(
       FmcjExecutionServiceHandle  service,
       char const *                oid,
       FmcjProcessInstanceHandle * hdlInstance )
```

C++

```
APIRET PersistentObject( FmcjExecutionService const & service,
                         string const &               oid )
```

Java

```
public abstract
  ProcessInstance ExecutionService.persistentObject( String oid )
throws FmcException
```

COBOL

```
        FmcjPIPersistentObj.

           CALL    "FmcjProcessInstancePersistentObject"
                          USING
                          BY VALUE
                             serviceValue
                             oid
                          BY REFERENCE
                             hdlInstance
                          RETURNING
                             intReturnValue.
```

Parameters

hdlInstance Input/Output. The address of the handle to the process instance object to be set.

oid Input. The object identifier of the process instance to be retrieved.

service Input. The service object representing the session with the execution server.

Return type

long/ APIRET The result of making this API call - see return codes below.

ProcessInstance

The process instance retrieved.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)

A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)

The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The process instance no longer exists.
FMC_ERROR_INVALID_OID(805)
The provided oid is invalid.
FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Refresh()

This API call refreshes the process instance from the MQSeries Workflow execution server (action call).

All information about the process instance, primary and secondary, is retrieved.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Process authorization
- Process administration authorization
- Be the process instance creator
- Be the process administrator
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProcessInstance
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjProcessInstanceRefresh( FmcjProcessInstanceHandle hdlInstance )
```

C++

```
APIRET Refresh()
```

Java

```
public abstract
void   refresh() throws FmcException
```

COBOL

```
        FmcjPIRefresh.

           CALL    "FmcjProcessInstanceRefresh"
                          USING
                          BY VALUE
                             hdlInstance
                          RETURNING
                             intReturnValue.
```

Parameters

hdlInstance Input. The handle of the process instance object to be refreshed.

Return type

long/ APIRET The result of making this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The process instance no longer exists.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Restart()

This API call restarts the process instance on the MQSeries Workflow execution server (action call).

Only *finished* or *terminated* top-level process instances can be restarted. The process administrator does not change. The process starter is set to the requester of this API call.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Process administration authorization
- Be the process administrator
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProcessInstance
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjProcessInstanceRestart( FmcjProcessInstanceHandle hdlInstance )
```

C++

```
APIRET Restart()
```

Java

```
public abstract
void   restart() throws FmcException
```

COBOL

```
FmcjPIRestart.

   CALL    "FmcjProcessInstanceRestart"
                  USING
                  BY VALUE
                     hdlInstance
                  RETURNING
                     intReturnValue.
```

Parameters

hdlInstance Input. The handle of the process instance object to be restarted.

Return type

long/ APIRET The result of making this API call - see return codes below.

Return codes

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The process instance no longer exists.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_WRONG_KIND(501)
The process instance is no top-level process instance.

FMC_ERROR_WRONG_STATE(120)
The process instance is in the wrong state.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Resume()

This API call resumes processing of a suspended or suspending process instance (action call).

All non-autonomous subprocesses with respect to control autonomy are also resumed, if the deep option is true.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Process administration authorization
- Be the process administrator
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProcessInstance
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjProcessInstanceResume( FmcjProcessInstanceHandle hdlInstance,
                           bool                      deep )
```

C++

```
APIRET Resume( bool deep )
```

Java

```
public abstract
void   resume( boolean deep ) throws FmcException
```

COBOL

```
        FmcjPIResume.

           CALL    "FmcjProcessInstanceResume"
                          USING
                          BY VALUE
                             hdlInstance
                             deep
                          RETURNING
                             intReturnValue.
```

Parameters

deep	Input. If deep is true, processing of all non-autonomous subprocesses is also resumed.
hdlInstance	Input. The handle of the process instance to be resumed.

Return type
long/ APIRET The result of making this API call - see return codes below.

Return codes/ FmcException
FMC_OK(0) The API call completed successfully.
FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.
FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.
FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_DOES_NOT_EXIST(118)
The process instance no longer exists.
FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_WRONG_STATE(120)
The process instance is in the wrong state.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

SetDescription()

This API call sets the description of the process instance to the specified value (action call).

If no description is provided, the description of the process instance is erased.

The following rules apply for specifying a process instance description:

- You can specify a maximum of 254 characters.
- You can use any printable characters depending on your current locale, including the end-of-line and new-line characters.

Usage notes
- See “Action API calls” on page 122 for general information.

Authorization

One of:
- Process authorization
- Process administration authorization
- Be the process instance creator
- Be the process administrator
- Be the system administrator

ProcessInstance

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProcessInstance
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjProcessInstanceSetDescription(
       FmcjProcessInstanceHandle hdlInstance,
       char const *              description )
```

C++

```
APIRET SetDescription( string const * description )
```

Java

```
public abstract
void   setDescription( String  description ) throws FmcException
```

COBOL

```
         FmcjPISetDescription.

            CALL    "FmcjProcessInstanceSetDescription"
                           USING
                           BY VALUE
                              hdlInstance
                              description
                           RETURNING
                              intReturnValue.
```

Parameters

description Input. The description or a pointer to the description to be set; can be a NULL (0) pointer or null object (Java).

hdlInstance Input. The handle of the process instance object whose description is to be set.

Return type

long/ APIRET The result of making this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.
FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_DOES_NOT_EXIST(118)
The process instance no longer exists.
FMC_ERROR_INVALID_DESCRIPTION(810)
The description does not conform to the syntax rules.
FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

SetName()

This API call sets the name of the process instance to the specified value (action call).

The process instance must still be in the *Ready* state.

The following rules apply for specifying a process instance name:

- You can specify a maximum of 63 characters.
- You can use any printable characters depending on your current locale, except the following:

  ```
  * ? " ; : . $
  ```
- You can use blanks with these restrictions: no leading blanks, no trailing blanks, and no consecutive blanks.

Usage notes

- See “Action API calls” on page 122 for general information.

Authorization

One of:

- Process authorization
- Process administration authorization
- Be the process instance creator
- Be the process administrator
- Be the system administrator

Required connection

MQSeries Workflow execution server

ProcessInstance

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProcessInstance
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjProcessInstanceSetName( FmcjProcessInstanceHandle hdlInstance,
                            char const *              name )
```

C++

```
APIRET SetName( string const & name )
```

Java

```
public abstract
void   setName( String name ) throws FmcException
```

COBOL

```
         FmcjPISetName.

            CALL    "FmcjProcessInstanceSetName"
                           USING
                           BY VALUE
                              hdlInstance
                              name
                           RETURNING
                              intReturnValue.
```

Parameters

hdlInstance Input. The handle of the process instance object whose name is to be set.

name Input. The name to be set.

Return type

long/ APIRET The result of making this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_DOES_NOT_EXIST(118)
The process instance no longer exists.
FMC_ERROR_INVALID_NAME(134)
The name does not conform to the syntax rules.
FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_NOT_UNIQUE(121)
The process instance name is not unique.
FMC_ERROR_WRONG_STATE(120)
The process instance is in the wrong state.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Start()

This API call starts a ready process instance (action call).

When successfully executed, the starter is set to the requester of this action and the process administrator is determined.

When initial values are to be passed to the process instance to be started, an input container can be provided (see also FmcjProcessInstance:: InContainer()). When the process instance requires input and is started without specifying an input container, the input-container values are not set. So, when, for example, input-container values are queried from within an activity implementation, FMC_ERROR_MEMBER_NOT_SET is returned.

For Java programs, start2() additionally allows to pass an input container.

Usage notes
- See “Action API calls” on page 122 for general information.

Authorization

One of:
- Process authorization
- Process administration authorization
- Be the process instance creator
- Be the process administrator
- Be the system administrator

Required connection

ProcessInstance

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProcessInstance
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjProcessInstanceStart( FmcjProcessInstanceHandle    hdlInstance,
                          FmcjReadWriteContainerHandle input )
```

C++

```
APIRET Start()

APIRET Start( FmcjReadWriteContainer const & input )
```

Java

```
public abstract
void   start() throws FmcException

public abstract
void   start2( ReadWriteContainer input ) throws FmcException
```

COBOL

```
        FmcjPIStart.

           CALL    "FmcjProcessInstanceStart"
                          USING
                          BY VALUE
                             hdlInstance
                             inputValue
                          RETURNING
                             intReturnValue.
```

Parameters

hdlInstance Input. The handle of the process instance object to be started.
input Input. The input container of the process instance.

Return type

long/ APIRET The result of making this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.
FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.
FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_DOES_NOT_EXIST(118)
The process instance no longer exists.
FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_WRONG_STATE(120)
The process instance is in the wrong state.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Suspend()

This API call suspends (temporarily stops) the process instance (action call).

The process instance must be in state *Running*. All non-autonomous subprocesses with respect to control autonomy are also suspended if the deep option is true. Autonomous subprocesses are not considered.

The process instance remains in state *Suspending* as long as there are running program activity implementations or suspending non-autonomous subprocesses. When the activity implementations completed their executions and when the non-autonomous subprocesses reached the *Suspended* state, the process instance is put into the *Suspended* state.

Optionally, a date may be specified up to when the process instance is suspended; it is then automatically resumed, together with the non-autonomous subprocesses, if the deep option had been specified.

For Java programs, suspend2() additionally allows to provide a date at which the process instance is automatically resumed.

Usage notes
- See “Action API calls” on page 122 for general information.

Authorization

One of:
- Process administration authorization
- Be the process administrator
- Be the system administrator

ProcessInstance

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProcessInstance
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjProcessInstanceSuspend(
       FmcjProcessInstanceHandle  hdlInstance,
       bool                       deep )

APIRET FMC_APIENTRY FmcjProcessInstanceSuspendUntil(
       FmcjProcessInstanceHandle  hdlInstance,
       FmcjCDateTime const *      time,
       bool                       deep )
```

C++

```
APIRET Suspend( bool deep )

APIRET Suspend( FmcjDateTime const & time, bool deep )
```

Java

```
public abstract
void   suspend( boolean deep ) throws FmcException

public abstract
void   suspend2( Calendar time, boolean deep ) throws FmcException
```

COBOL

```
        FmcjPISuspend.

           CALL    "FmcjProcessInstanceSuspend"
                         USING
                         BY VALUE
                            hdlInstance
                            deep
                         RETURNING
                            intReturnValue.
```

Parameters

deep	Input. An indicator whether also non-autonomous subprocesses are to be suspended.
hdlInstance	Input. The handle of the process instance object to be suspended.
time	Input. The date/time or a pointer to the date/time until which the process instance is to be suspended.

Return type
long/ APIRET The result of making this API call - see return codes below.

Return codes/ FmcException
FMC_OK(0) The API call completed successfully.
FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.
FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.
FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_DOES_NOT_EXIST(118)
The process instance no longer exists.
FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_WRONG_STATE(120)
The process instance is in the wrong state.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Terminate()

This API call terminates a process instance and all of its non-autonomous subprocesses (action call).

The process instance must be in states *Running*, *Suspended*, or *Suspending*.

The process instance is put into state terminating as long as there are running activity implementations or terminating non-autonomous subprocesses. When the activity implementations completed their executions or when the non-autonomous subprocesses terminated, the process instance is put into the *Terminated* state. When the process instance has reached the *Terminated* state, it is deleted depending on the setting of the "delete finished items" option.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Process administration authorization
- Be the process administrator
- Be the system administrator

ProcessInstance

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProcessInstance
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjProcessInstanceTerminate( FmcjProcessInstanceHandle hdlInstance )
```

C++

```
APIRET Terminate()
```

Java

```
public abstract
void   terminate() throws FmcException
```

COBOL

```
         FmcjPITerminate.

            CALL    "FmcjProcessInstanceTerminate"
                           USING
                           BY VALUE
                              hdlInstance
                           RETURNING
                              intReturnValue.
```

Parameters

hdlInstance Input. The handle of the process instance object to be terminated.

Return type

long/ APIRET The result of making this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_DOES_NOT_EXIST(118)
The process instance no longer exists.
FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_WRONG_STATE(120)
The process instance is in the wrong state.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

ProcessInstanceList actions

A process instance list represents a set of process instances. All process instances which are accessible through this list have the same characteristics. These characteristics are specified by a filter. Additionally, sort criteria can be applied and, after that, a threshold to restrict the number of process instances to be transferred from the execution server to the client.

The process instance list definition is stored persistently.

A process instance list is uniquely identified by its name, type, and owner. It can be defined for general access purposes; it is then of a *public* type. Or, it can be defined for some specific user; it is then of a *private* type.

Other lists that can be defined are process template lists or worklists. FmcjPersistentList or PersistentList represents the common properties of all lists.

In C++, FmcjProcessInstanceList is a subclass of the FmcjPersistentList class and inherits all properties and methods. In the Java language, ProcessInstanceList is thus a subclass of the PersistentList class and inherits all properties and methods. Similarly, in C or COBOL, common implementations of functions are taken from FmcjPersistentList. That is, common functions start with the prefix FmcjPersistentList; they are also defined starting with the prefix FmcjProcessInstanceList.

The following sections describe the actions which can be applied on a process instance list. See “ProcessInstanceList” on page 268 for a complete list of API calls.

QueryProcessInstances()

This API call retrieves the primary information for all process instances characterized by the specified process instance list from the MQSeries Workflow execution server (action call).

ProcessInstanceList

From the set of qualifying process instances, only those are retrieved the user is authorized for. The user is authorized for a process instance if the process instance:
- Does not belong to any category
- Does belong to a category and the user has global process authorization or global process administration authorization or selected process authorization or selected process administration authorization for that category

The primary information that is retrieved for each process instance is:
- Category
- Description
- Icon
- InContainerNeeded
- LastModificationTime
- LastStateChangeTime
- Name
- ParentName
- ProcessTemplateName
- StartTime
- State
- SuspensionExpirationTime
- SuspensionTime
- SystemName
- SystemGroupName
- TopLevelName

In C, C++, and COBOL, any process instances retrieved are appended to the supplied vector of process instances. If you want to read those process instances only which are currently included in the process instance list, you have to clear the vector before you issue this API call.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProcessInstanceList
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjProcessInstanceListQueryProcessInstances(
       FmcjProcessInstanceListHandle      hdlList,
       FmcjProcessInstanceVectorHandle *  instances )
```

C++

```
APIRET QueryProcessInstances(
       vector<FmcjProcessInstance> & instances ) const
```

Java

```
public abstract
ProcessInstance[] queryProcessInstances() throws FmcException
```

COBOL

```
        FmcjPILQueryProcInsts.

           CALL    "FmcjProcessInstanceListQueryProcessInstances"
                          USING
                          BY VALUE
                             hdlList
                          BY REFERENCE
                             instances
                          RETURNING
                             intReturnValue.
```

Parameters

hdlList Input. The handle of the process instance list to be queried.

instances Input/Output. The vector of qualifying process instances.

Return type

long/ APIRET The result returned by this API call - see return codes below.

ProcessInstance[]
The qualifying process instances.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The process instance list no longer exists.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples
- For a C example see "Query worklists (C)" on page 536
- For a C++ example see "Query worklists (C++)" on page 538
- For a COBOL example, see "Query worklists (COBOL)" on page 542

ProcessInstanceNotification actions

A ProcessInstanceNotification object represents a notification on a process instance assigned to a user.

Other items assigned to users are activity instance notifications and work items. FmcjItem or Item represents the common properties of all items.

In C++, FmcjProcessInstanceNotification is thus a subclass of the FmcjItem class and inherits all properties and methods. In Java, ProcessInstanceNotification is thus a subclass of the Item class and inherits all properties and methods. Similarly, in C or COBOL, common implementations of functions are taken from FmcjItem. That is, common functions start with the prefix FmcjItem; they are also defined starting with the prefix FmcjProcessInstanceNotification.

A process instance notification is uniquely identified by its object identifier.

The following sections describe the actions which can be applied on a process instance notification. See "ProcessInstanceNotification" on page 269 for a complete list of API calls.

PersistentObject()

This API call retrieves the process instance notification identified by the passed object identifier from the MQSeries Workflow execution server (action call).

The MQSeries Workflow execution server from which the process instance notification is to be retrieved is identified by the execution service object. The transient object is then created or updated with all information - primary and secondary - of the process instance notification.

In C++, when the process instance notification object to be initialized is not empty, that object is destructed before the new one is assigned. In C, the application is completely responsible for the ownership of objects, that is, it is not checked whether the process instance notification handle already points to some object. In Java, a process instance notification is newly created; the execution service acts as a factory.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Be the item owner
- Work item authorization

- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjProcessInstanceNotificationPersistentObject(
       FmcjExecutionServiceHandle               service,
       char const *                             oid,
       FmcjProcessInstanceNotificationHandle *  hdlItem )
```

C++

```
APIRET PersistentObject( FmcjExecutionService const & service,
                         string const &               oid )
```

Java

```
public abstract
  ProcessInstanceNotification
  ExecutionService.processInstanceNotification( String oid )
throws FmcException
```

COBOL

```
        FmcjPINPersistentObj.

           CALL    "FmcjProcessInstanceNotificationPersistentObject"
                          USING
                          BY VALUE
                             serviceValue
                             oid
                          BY REFERENCE
                             hdlItem
                          RETURNING
                             intReturnValue.
```

Parameters

hdlItem	Input/Output. The address of the handle to the process instance notification object to be set.
oid	Input. The object identifier of the process instance notification to be retrieved.
service	Input. The service object representing the session with the execution server.

ProcessInstanceNotification

Return type
long/ APIRET The result returned by this API call - see return codes below.
ProcessInstanceNotification
The process instance notification retrieved.

Return codes/ FmcException
FMC_OK(0) The API call completed successfully.
FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.
FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_DOES_NOT_EXIST(118)
The process instance notification .
FMC_ERROR_INVALID_OID(805)
The provided oid is invalid.
FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

ProcessTemplate actions

A ProcessTemplate object is the frozen state of a process model from which it is created via translation. All program definitions and data structures referenced by the process model are copied into the process template (early binding). Subprocesses are bound lately. Their definitions are only located during execution.

A process template is uniquely identified by its object identifier or by its name and a valid-from date. This *valid-from date* determines since when the process template can be used to create process instances.

When process templates are queried from the execution server, then only currently valid process templates are returned.

The following sections describe the actions which can be applied on a process template. See “ProcessTemplate” on page 271 for a complete list of API calls.

CreateAndStartInstance()

This API call creates a process instance from the specified process template and starts the resulting process instance (action call).

Depending on the keepName option, a process instance name must be provided. If the process instance name is to be kept *as is*, you cannot provide an empty string.

The following rules apply for specifying a process instance name:

- You can specify a maximum of 63 characters.
- You can use any printable characters depending on your current locale, except the following:

  ```
  * ? " ; : . $
  ```

- You can use blanks with these restrictions: no leading blanks, no trailing blanks, and no consecutive blanks.

If a unique name may be generated by MQSeries Workflow, the following applies:

- If no or an empty process instance name is provided, an instance is created with a default name *ProcessTemplateName$Oid*, where *Oid* is a printable version of the process instance object identifier. Since the process instance name cannot be longer than 63 characters, the process template name can be shortened.
- If a process instance name is provided, that name is kept as long as it is unique. If the provided process instance name is already used for another instance, an instance is created with the name *name$Oid*, where *Oid* is a printable version of the process instance object identifier. Since the process instance name cannot be longer than 63 characters, the name can be shortened.

The passed name parameter value remains unchanged; FmcjProcessInstance::Name() returns the actual name of the process instance created. The newly created process instance contains the primary attribute values only.

When initial values are to be passed to the process instance to be created and started, an input container can be provided - see also FmcjProcessTemplate::InContainer(). When a process instance that requires input is started without specifying an input container, the input-container values are not set. When, for example, input-container values are queried from within an activity implementation, FMC_ERROR_MEMBER_NOT_SET is returned.

Pass a NULL (0) pointer or an empty string for the reserved parameters.

See createAndStartInstance; additionally allows to pass an input container.

Usage notes

- See “Action API calls” on page 122 for general information.

Authorization

One of:

- Process authorization
- Process administration authorization
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProcessTemplate

ProcessTemplate

COBOL fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjProcessTemplateCreateAndStartInstance(
       FmcjProcessTemplateHandle     hdlTemplate,
       char const *                  name,
       char const *                  reserved1,
       char const *                  reserved2,
       FmcjReadWriteContainerHandle  input,
       bool                          keepName,
       FmcjProcessInstanceHandle *   newInstance )
```

C++

```
APIRET CreateAndStartInstance(
       string const *                name,
       string const *                reserved1,
       string const *                reserved2,
       FmcjProcessInstance &         newInstance,
       bool                          keepName = false ) const;

APIRET CreateAndStartInstance(
       string const *                name,
       string const *                reserved1,
       string const *                reserved2,
       FmcjReadWriteContainer const & input,
       FmcjProcessInstance &         newInstance,
       bool                          keepName = false ) const;
```

Java

```
public abstract
ProcessInstance createAndStartInstance(
                String                name,
                String                reserved1,
                String                reserved2,
                boolean               keepName ) throws FmcException

public abstract
ProcessInstance createAndStartInstance2(
                String                name,
                String                reserved1,
                String                reserved2,
                ReadWriteContainer    input,
                boolean               keepName ) throws FmcException
```

XML

```
<!-- ProcessTemplateCreateAndStart ================== -->
<!ELEMENT ProcessTemplateCreateAndStartInstance
          ( ProcTemplName,
            ProcInstName,
            KeepName,
            ProcInstInputData ) >
<!ELEMENT ProcTemplName             (#PCDATA) >
<!ELEMENT ProgInstName              (#PCDATA) >
<!ELEMENT KeepName                  (#PCDATA) >
               <!--  Expected values: {true, false} -->
<!ELEMENT ProcInstInputData (%CONTAINER;) >

<!ELEMENT ProcessTemplateCreateAndStartInstanceResponse
          ( ProcessInstance
          | Exception ) >
<!ELEMENT ProcessInstance
          ( ProcInstID,
            ProcInstName,
            ProcInstParentName?,
            ProcInstTopLevelName,
            ProcInstDescription?,
            ProcInstState,
            LastStateChangeTime,
            LastModificationTime,
            ProcTemplID,
            ProcTemplName,
            Icon,
            Category? ) >

<!ELEMENT ProcInstID                (#PCDATA) >
<!ELEMENT ProcInstDescription       (#PCDATA) >
<!ELEMENT ProcInstName              (#PCDATA) >
<!ELEMENT ProcInstParentName        (#PCDATA) >
<!ELEMENT ProcInstTopLevelName      (#PCDATA) >
<!ELEMENT ProcInstState             (#PCDATA)  >
               <!-- Expected values: {Ready,Running,Finished,Terminated,
                                     Suspended, Terminating,
                                     Suspending,Deleted} -->
<!ELEMENT LastModificationTime      (#PCDATA) >
<!ELEMENT LastStateChangeTime       (#PCDATA) >
<!ELEMENT ProcTemplID               (#PCDATA) >
<!ELEMENT ProcTemplName             (#PCDATA) >
<!ELEMENT Icon                      (#PCDATA) >
<!ELEMENT Category                  (#PCDATA) >
<!ELEMENT Exception
          (Rc, Parameters, MessageText?, Origin) >
          <!-- Message text is optional, as it will be ignored
               in messages being sent *to* the Wf server. -->
<!ELEMENT Parameters
          (Parameter*) >
<!ELEMENT Parameter                 (#PCDATA) >
<!ELEMENT Rc                        (#PCDATA) >
<!ELEMENT MessageText               (#PCDATA) >
<!ELEMENT Origin                    (#PCDATA) >
```

COBOL

```
FmcjPTCreateAndStartInst.

   CALL    "FmcjProcessTemplateCreateAndStartInstance"
                  USING
                  BY VALUE
                     hdlTemplate
                     name
                     reserved1
                     reserved2
                     inputValue
                     keepName
                  BY REFERENCE
                     newInstance
                  RETURNING
                     intReturnValue.
```

Parameters

hdlTemplate Input. The handle of the process template object to be used.
input Input. The input container of the process instance.
keepName Input. True, if only the specified name can be used for the process instance. False, if a unique name can be generated.
name Input. The name of the process instance to be created and started.
newInstance Input/Output. The newly created and started process instance.
returnCode Input/Output. The result of calling this method - see below.
reserved1/reserved2
Input. Pass a 0 (NULL) pointer or an empty string.

Return type

APIRET The return code from this API call - see return codes below.
ProcessInstance*/ ProcessInstance
A pointer to the newly created and started process instance or the newly created and started process instance.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.
FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.
FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.
FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_DOES_NOT_EXIST(118)
The process template no longer exists or is no longer valid.
FMC_ERROR_INVALID_NAME(134)
The specified process instance name does not comply with the syntax rules.
FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_NOT_UNIQUE(121)
The name of the process instance is not unique.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.
FMC_ERROR_XML_DOCUMENT_INVALID(1100)
The document is not a valid XML document.
FMC_ERROR_XML_NO_MQSWF_DOCUMENT(1101)
The document is not a valid MQSeries Workflow XML document.
FMC_ERROR_XML_WRONG_DATA_STRUCTURE(1103)
The type of the container is incorrect.
FMC_ERROR_XML_DATA_MEMBER_NOT_FOUND(1104)
The specified data member is not part of the container.
FMC_ERROR_XML_DATA_MEMBER_WRONG_TYPE(1105)
The type of the data member value passed is incorrect.

XML example

```
<ProcessTemplateCreateAndStartInstance>
   <ProcTemplName>OnlineCreditRequest</ProcTemplName>
   <ProgInstName>Credit Request #658321<ProgInstName>
   <KeepName>true</KeepName>
   <ProcInstInputData>
      <CreditData>
        <!-- here comes the data for data structure CreditData -->
      </CreditData>
   </ProcInstInputData>
</ProcessTemplateCreateAndStartInstance>

<ProcessTemplateCreateAndStartInstanceResponse>
    <ProcessInstance>
      <ProcInstID>42424242EFEFEFEF</ProcInstID>
      <ProcInstName>Credit Request#658321</ProcInstName>
      <ProcInstTopLevelName>Credit Request#658321</ProcInstTopLevelName>
      <ProcInstDescription>Sample description</ProcInstDescription>
      <ProcInstState>Finished</ProcInstState>
      <LastStateChangeTime>1999-05-18 14:35:00</LastStateChgTime>
      <LastModificationTime>1999-05-19 23:40:00</LastModTime>
      <ProcTemplID>84848484FEFEFEFE</ProcTemplID>
      <ProcTemplName>OnlineCreditRequest</ProcTemplName>
      <Icon>fmcpcred</Icon>
      <Category>Finance</Category>
    </ProcessInstance>
 </ProcessTemplateCreateAndStartInstanceResponse>
```

CreateInstance()

This API call creates a process instance from the specified process template (action call).

Depending on the keepName option, a process instance name must be provided. If the process instance name is to be kept *as is*, you cannot provide an empty string.

The following rules apply for specifying a process instance name:

- You can specify a maximum of 63 characters.
- You can use any printable characters depending on your current locale, except the following:

  ```
  * ? " ; : . $
  ```
- You can use blanks with these restrictions: no leading blanks, no trailing blanks, and no consecutive blanks.

If a unique name may be generated by MQSeries Workflow, the following applies:

- If no name or an empty process instance name is provided, an instance is created with a default name *ProcessTemplateName$Oid*, where *Oid* is a printable version of the process instance object identifier. Since the process instance name cannot be longer than 63 characters, the process template name can be shortened.
- If a process instance name is provided, that name is kept as long as it is unique. If the provided process instance name is already used for another instance, an instance is created with the name *name$Oid*, where *Oid* is a printable version of the process instance object identifier. Since the process instance name cannot be longer than 63 characters, the name can be shortened.

The passed name parameter value remains unchanged; FmcjProcessInstance::Name() returns the actual name of the process instance created. The newly created process instance contains the primary attribute values only.

Pass a NULL (0) pointer or an empty string for the reserved parameters.

Usage notes

- See “Action API calls” on page 122 for general information.

Authorization

One of:

- Process authorization
- Process administration authorization
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProcessTemplate
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjProcessTemplateCreateInstance(
       FmcjProcessTemplateHandle   hdlTemplate,
       char const *                name,
       char const *                reserved1,
       char const *                reserved2,
       bool                        keepName,
       FmcjProcessInstanceHandle * newInstance )
```

C++

```
APIRET CreateInstance(
       string const *        name,
       string const *        reserved1,
       string const *        reserved2,
       FmcjProcessInstance & newInstance,
       bool                  keepName = false ) const
```

Java

```
public abstract
ProcessInstance createInstance(
                String        name,
                String        reserved1,
                String        reserved2,
                boolean       keepName ) throws FmcException
```

COBOL

```
         FmcjPTCreateInst.

            CALL    "FmcjProcessTemplateCreateInstance"
                           USING
                           BY VALUE
                              hdlTemplate
                              name
                              reserved1
                              reserved2
                              keepName
                           BY REFERENCE
                              newInstance
                           RETURNING
                              intReturnValue.
```

Parameters

hdlTemplate Input. The handle of the process template object to be used.

keepName Input. True, if only the specified name can be used for the process instance. False, if a unique name can be generated.

name Input. The name of the process instance to be created.

newInstance Input/Output. The newly created process instance.

reserved1/reserved2
Input. Pass a 0 (NULL) pointer or an empty string.

returnCode Input/Output. The result of calling this method - see below.

Return type

APIRET The return code from this API call - see return codes below.

ProcessInstance*/ ProcessInstance
A pointer to the newly created process instance or the newly created process instance.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The process template no longer exists or is no longer valid.

FMC_ERROR_INVALID_NAME(134)
The specified process instance name does not comply with the syntax rules.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_NOT_UNIQUE(121)
The name of the process instance is not unique.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Delete()

This API call deletes the specified process template(s) from the execution server (action call).

Since process templates are versioned, you can specify whether you want to delete the currently valid process template, the past versions of the process template, or the future versions of the process template. When all options are specified, all versions of the process template are deleted. Deletion always applies to the currently existing process templates only.

For Java programs, delete2() additionally allows for specifying the versions to be deleted.

There are no impacts on your transient representation of the process template; in C, C++, or COBOL, you must destruct or deallocate the transient object when it is no longer needed.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Process modeling authorization
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProcessTemplate
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjProcessTemplateDelete( FmcjProcessTemplateHandle hdlTemplate,
                           bool                      pastVersions,
                           bool                      currentVersion,
                           bool                      futureVersions )
```

C++

```
APIRET Delete( bool pastVersions  = true,
               bool currentVersion= true,
               bool futureVersions= true )
```

Java

```
public abstract
void   delete() throws FmcException

public abstract
void   delete2( boolean pastVersions,
                boolean currentVersion,
                boolean futureVersions ) throws FmcException
```

COBOL

```
FmcjPTDelete.

   CALL    "FmcjProcessTemplateDelete"
                  USING
                  BY VALUE
                     hdlTemplate
                  RETURNING
                     intReturnValue.
```

Parameters

currentVersion Input. An indication whether the current version of this process template is to be deleted.

futureVersions Input. An indication whether future versions of this process template are to be deleted.

hdlTemplate Input. The handle of the process template to be deleted.

pastVersions Input. An indication whether past versions of this process template are to be deleted.

Return type

long/ APIRET The result returned by this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The process template or its specified versions no longer exist.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

ExecuteProcessInstance()

This API call creates a process instance from the specified process template and executes the resulting process instance (action call).

The program execution server must have been started so that the activity implementations are executed.

This API call can be issued synchronously or asynchronously. When called synchronously, the process instance should be fast enough to complete within the application wait time. When called asynchronously, a user context can be specified to correlate the response received later. Additionally, a correlation ID can be received which can be used to wait for the specific response. If a buffer to hold the correlation ID is specified, then it must initially point to FMCJ_NO_CORRELID.

Depending on the keepName option, a process instance name must be provided. If the process instance name is to be kept *as is*, you cannot provide an empty string.

The following rules apply for specifying a process instance name:

- You can specify a maximum of 63 characters.
- You can use any printable characters depending on your current locale, except the following:

  `* ? " ; : . $`
- You can use blanks with these restrictions: no leading blanks, no trailing blanks, and no consecutive blanks.

If a unique name may be generated by MQSeries Workflow, the following applies:

- If no or an empty process instance name is provided, an instance is created with a default name *ProcessTemplateName$Oid*, where *Oid* is a printable version of the process instance object identifier. Since the process instance name cannot be longer than 63 characters, the process template name can be shortened.
- If a process instance name is provided, that name is kept as long as it is unique. If the provided process instance name is already used for another instance, an instance is created with the name *name$Oid*, where *Oid* is a printable version of the process instance object identifier. Since the process instance name cannot be longer than 63 characters, the name can be shortened.

The passed name parameter value remains unchanged; FmcjProcessInstance::Name() returns the actual name of the process instance created. The newly created process instance contains all attributes, primary and secondary.

When initial values are to be passed to the process instance to be created and started, an input container can be provided - see also FmcjProcessTemplate::InContainer(). When a process instance that requires input is started without specifying an input container, the input-container values are not set. When, for example, input-container values are queried from within an activity implementation, FMC_ERROR_MEMBER_NOT_SET is returned.

Pass a NULL (0) pointer or an empty string for the reserved parameters.

On completion, the executed process instance and its output container are returned. The process instance contains values for the primary attributes only. In case of process instance termination, a container is not returned, that is, a 0-pointer or empty container is returned.

Usage notes

- See “Action API calls” on page 122 for general information.

Authorization

ProcessTemplate

One of:
- Process authorization
- Process administration authorization
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	not supported

C

```
APIRET FMC_APIENTRY FmcjProcessTemplateExecuteProcessInstance(
       FmcjProcessTemplateHandle     hdlTemplate,
       char const *                  name,
       char const *                  reserved1,
       char const *                  reserved2,
       FmcjReadWriteContainerHandle  input,
       bool                          keepName,
       FmcjProcessInstanceHandle *   newInstance,
       FmcjReadOnlyContainerHandle * output     )

APIRET FMC_APIENTRY FmcjProcessTemplateExecuteProcessInstanceAsync(
       FmcjProcessTemplateHandle     hdlTemplate,
       char const *                  name,
       char const *                  reserved1,
       char const *                  reserved2,
       FmcjReadWriteContainerHandle  input,
       bool                          keepName,
       FmcjCorrelID *                correlID,
       char const *                  userContext )
```

C++

```
APIRET ExecuteProcessInstance(
       FmcjProcessInstance &           newInstance,
       FmcjReadOnlyContainer &         output,
       string const *                  name = 0,
       string const *                  reserved1 = 0,
       string const *                  reserved2 = 0,
       bool                            keepName = false ) const

APIRET ExecuteProcessInstance(
       FmcjReadWriteContainer const &  input,
       FmcjProcessInstance &           newInstance,
       FmcjReadOnlyContainer &         output,
       string const *                  name = 0,
       string const *                  reserved1 = 0,
       string const *                  reserved2 = 0,
       bool                            keepName = false ) const

APIRET ExecuteProcessInstanceAsync(
       string const *                  name = 0,
       string const *                  reserved1 = 0,
       string const *                  reserved2 = 0,
       bool                            keepName = false,
       FmcjCorrelID  *                 correlID = 0,
       string const *                  userContext = 0 )

APIRET ExecuteProcessInstanceAsync(
        FmcjReadWriteContainer const & input,
        string const *                 name = 0,
        string const *                 reserved1 = 0,
        string const *                 reserved2 = 0,
        bool                           keepName = false,
        FmcjCorrelID  *                correlID = 0,
        string const *                 userContext = 0 )
```

XML

```
<!-- ProcessTemplateExecute ========================== -->
<!ELEMENT ProcessTemplateExecute
          ( ProcTemplName,
            ProcInstName,
            KeepName,
            ProcInstInputData ) >
<!ELEMENT ProcTemplName             (#PCDATA) >
<!ELEMENT ProgramName               (#PCDATA) >
<!ELEMENT KeepName                  (#PCDATA) >
                            <!--  Expected values: {true, false} -->
<!ELEMENT ProcInstInputData (%CONTAINER;) >
<!ELEMENT ProcessTemplateExecuteResponse
          ( ( ProcessInstance,
              ProcInstOutputData )
          | Exception ) >
<!ELEMENT ProcessInstance
          ( ProcInstID,
            ProcInstName,
            ProcInstParentName?,
            ProcInstTopLevelName,
            ProcInstDescription?,
            ProcInstState,
            LastStateChangeTime,
            LastModificationTime,
            ProcTemplID,
            ProcTemplName,
            Icon,
            Category? ) >

<!ELEMENT ProcInstID                (#PCDATA) >
<!ELEMENT ProcInstDescription       (#PCDATA) >
<!ELEMENT ProcInstName              (#PCDATA) >
<!ELEMENT ProcInstParentName        (#PCDATA) >
<!ELEMENT ProcInstTopLevelName      (#PCDATA) >
<!ELEMENT ProcInstState             (#PCDATA)  >
     <!-- Expected values: { Ready,      Running,
                                  Finished,   Terminated,
                                  Suspended,  Terminating,
                                  Suspending, Deleted    } -->
<!ELEMENT LastModificationTime      (#PCDATA) >
<!ELEMENT LastStateChangeTime       (#PCDATA) >
<!ELEMENT ProcTemplID               (#PCDATA) >
<!ELEMENT ProcTemplName             (#PCDATA) >
<!ELEMENT Icon                      (#PCDATA) >
<!ELEMENT Category                  (#PCDATA) >
<!ELEMENT ProcInstOutputData        (%CONTAINER;) >
<!ELEMENT Exception
          (Rc, Parameters, MessageText?, Origin) >
          <!-- Message text is optional, as it will be ignored
               in messages being sent *to* the Wf server. -->
<!ELEMENT Parameters
          (Parameter*) >
<!ELEMENT Parameter                 (#PCDATA) >
<!ELEMENT Rc                        (#PCDATA) >
<!ELEMENT MessageText               (#PCDATA) >
<!ELEMENT Origin                    (#PCDATA) >
```

COBOL

```
FmcjPTExecuteProcInst.

   CALL    "FmcjProcessTemplateExecuteProcessInstance"
                  USING
                  BY VALUE
                     hdlTemplate
                     name
                     reserved1
                     reserved2
                     inputValue
                     keepName
                  BY REFERENCE
                     newInstance
                     outputValue
                  RETURNING
                     intReturnValue.

FmcjPTExecuteProcInstAsync.

   CALL    "FmcjProcessTemplateExecuteProcessInstanceAsync"
                  USING
                  BY VALUE
                     hdlTemplate
                     name
                     reserved1
                     reserved2
                     inputValue
                     keepName
                  BY REFERENCE
                     correlID
                  BY VALUE
                     userContext
                  RETURNING
                     intReturnValue.
```

Parameters

correlID Input/Output. If specified, contains the correlation ID by which this request can be correlated to a later response.

hdlTemplate Input. The handle of the process template object to be used.

input Input. The input container of the process instance.

keepName Input. True, if only the specified name can be used for the process instance. False, if a unique name can be generated.

name Input. The name of the process instance to be executed.

newInstance Input/Output. The executed process instance.

output Output. The output container of the process instance.

returnCode Input/Output. The result of calling this method - see below.

reserved1/reserved2
Input. Pass a 0 (NULL) pointer or an empty string.

userContext Input. A user-defined context which can be used for correlation.

Return type

APIRET The return code from this API call - see return codes below.

ProcessInstance*
A pointer to the newly created and executed process instance.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The process template no longer exists or is no longer valid.

FMC_ERROR_INVALID_CORRELATION_ID
The specified correlation ID does not point to FMCJ_NO_CORRELID.

FMC_ERROR_INVALID_NAME(134)
The specified process instance name does not comply with the syntax rules.

FMC_ERROR_INVALID_USER_CONTEXT(819)
The specified user context is longer than 254 characters.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_NOT_UNIQUE(121)
The name of the process instance is not unique.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

FMC_ERROR_XML_DOCUMENT_INVALID(1100)
The document is not a valid XML document.

FMC_ERROR_XML_NO_MQSWF_DOCUMENT(1101)
The document is not a valid MQSeries Workflow XML document.

FMC_ERROR_XML_WRONG_DATA_STRUCTURE(1103)
The type of the container is incorrect.

FMC_ERROR_XML_DATA_MEMBER_NOT_FOUND(1104)
The specified data member is not part of the container.

FMC_ERROR_XML_DATA_MEMBER_WRONG_TYPE(1105)
The type of the data member value passed is incorrect.

XML example

```
<ProcessTemplateExecute>
    <ProcTemplName>OnlineCreditRequest</ProcTemplName>
    <ProcInstName>Credit Request #658321</ProcInstName>
    <KeepName>true</KeepName>
    <ProcInstInputData>
      </CreditData>
       <!-- here comes the data for data structure CreditData -->
      </CreditData>
    </ProcInstInputData>
  </ProcessTemplateExecute>
```

```
<ProcessTemplateExecuteResponse>
    <ProcessInstance>
      <ProcInstID>42424242EFEFEFEF</ProcInstID>
      <ProcInstName>Credit Request #658321</ProcInstName>
      <ProcInstTopLevelName>Credit Request #658321</ProcInstTopLevelName>
      <ProcInstDescription>Sample description</ProcInstDescription>
      <ProcInstState>Finished</ProcInstState>
      <LastStateChangeTime>1999-05-18 14:35:00</LastStateChgTime>
      <LastModificationTime>1999-05-19 23:40:00</LastModTime>
      <ProcTemplID>84848484FEFEFEFE</ProcTemplID>
      <ProcTemplName>OnlineCreditRequest</ProcTemplName>
      <Icon>fmcpcred</Icon>
      <Category>Finance</Category>
    </ProcessInstance>
    <ProcInstOutputData>
      <CreditData>
      <!-- here comes the data structure data -->
      </CreditData>
    </ProcInstOutputData>
  </ProcessTemplateExecuteResponse>
```

InitialInContainer()

This API call retrieves the input container associated with the process template from the MQSeries Workflow execution server (action call).

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

One of:

- Process authorization
- Process administration authorization
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProcessTemplate
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjProcessTemplateInitialInContainer(
       FmcjProcessTemplateHandle      hdlTemplate,
       FmcjReadWriteContainerHandle * input )
```

C++

```
APIRET InContainer( FmcjReadWriteContainer & input )
```

Java

```
public abstract
ReadWriteContainer initialInContainer() throws FmcException
```

COBOL

```
        FmcjPTInitialInCtnr.

           CALL    "FmcjProcessTemplateInitialInContainer"
                          USING
                          BY VALUE
                             hdlTemplate
                          BY REFERENCE
                             inputValue
                          RETURNING
                             intReturnValue.
```

Parameters

hdlTemplate Input. The handle of the process template object whose input container is to be retrieved.

input Input/Output. The address of the input container handle or the input container of the process template to be set.

Return type

long/ APIRET The result returned by this API call - see return codes below.

ReadWriteContainer
The input container of the process template.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The process template no longer exists or is no longer valid.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

PersistentObject()

This API call retrieves the process template identified by the passed object identifier from the MQSeries Workflow execution server (action call).

The MQSeries Workflow execution server from which the process template is to be retrieved is identified by the execution service object. The transient object is then created or updated with all information - primary and secondary - of the process template.

In C++, when the process template object to be initialized is not empty, that object is destructed before the new one is assigned. In C, the application is completely responsible for the ownership of objects, that is, it is not checked whether the process template handle already points to some object. In Java, a process template is newly created; the execution service acts as a factory.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Process authorization
- Process administration authorization
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjProcessTemplatePersistentObject(
       FmcjExecutionServiceHandle  service,
       char const *                oid,
       FmcjProcessTemplateHandle * hdlTemplate )
```

C++

```
APIRET PersistentObject( FmcjExecutionService const & service,
                         string const &               oid )
```

Java

```
public abstract
  ProcessTemplate ExecutionService.processTemplate( String oid )
throws FmcException
```

COBOL

```
         FmcjPTPersistentObj.

            CALL    "FmcjProcessTemplatePersistentObject"
                           USING
                           BY VALUE
                              serviceValue
                              oid
                           BY REFERENCE
                              hdlTemplate
                           RETURNING
                              intReturnValue.
```

Parameters

hdlTemplate Input/Output. The address of the handle to the process template object to be set.

oid Input. The object identifier of the process template to be retrieved.

service Input. The service object representing the session with the execution server.

Return type

long/ APIRET The result returned by this API call - see return codes below.

ProcessTemplate

The process template retrieved.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)

A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)

The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)

The process template no longer exists or is no longer valid.

FMC_ERROR_INVALID_OID(805)

The provided oid is invalid.

FMC_ERROR_NOT_AUTHORIZED(119)

Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)

Not logged on.

FMC_ERROR_COMMUNICATION(13)

The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)

An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

ProgramTemplate()

This API call retrieves the program template identified by the name passed from the MQSeries Workflow execution server (action call).

A program template comprises data about its associated input and output containers, implementation data for all specified platforms and various other properties. In case *structures from activity* was specified for the program during Buildtime, no input or output container information is available; any container can be passed to the program when executed.

When containers are provided for a program template, they are initial containers. Therefore, no default values are set for data members. Also, predefined data members are not set.

The result of calling this API call is dependent on the system where the request is executed, because there are values returned that can be inherited from the system.

The program template is versioned within the context of the corresponding process template.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Process authorization
- Process administration authorization
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProcessTemplate
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjProcessTemplateProgramTemplate(
       FmcjProcessTemplateHandle   hdlTemplate,
       char const *                programName,
       FmcjProgramTemplateHandle * program )
```

C++

```
APIRET ProgramTemplate( string const &         programName,
                        FmcjProgramTemplate &  program    ) const
```

Java

```
public abstract
ProgramTemplate  programTemplate( String programName )
throws FmcException
```

COBOL

```
        FmcjPTProgramTempl.

           CALL    "FmcjProcessTemplateProgramTemplate"
                          USING
                          BY VALUE
                             hdlTemplate
                             programName
                          BY REFERENCE
                             programValue
                          RETURNING
                             intReturnValue.
```

Parameters

hdlTemplate Input. The handle of the process template where a program template is to be retrieved.

program Input/Output. The program template retrieved.

programName Input. The name of the program template to be retrieved.

Return type

APIRET The result of calling this API call - see return codes below.

ProgramTemplate/ProgramTemplate*

The program template or a pointer to the program template retrieved.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)

A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)

The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_BACK_LEVEL_OBJECT

The request can only be executed on process templates translated after MQSeries Workflow 3.2.1 has been installed.

FMC_ERROR_DOES_NOT_EXIST(118)

The process template no longer exists or is no longer valid or the program template does not exist within the process template.

FMC_ERROR_NOT_AUTHORIZED(119)

Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Refresh()

This API call refreshes the process template from the MQSeries Workflow execution server (action call).

All information about the process template - primary and secondary - is retrieved.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Process authorization
- Process administration authorization
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProcessTemplate
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjProcessTemplateRefresh( FmcjProcessTemplateHandle hdlTemplate )
```

C++

```
APIRET Refresh()
```

Java

```
public abstract
void   refresh() throws FmcException
```

COBOL

```
         FmcjPTRefresh.

            CALL    "FmcjProcessTemplateRefresh"
                           USING
                           BY VALUE
                              hdlTemplate
                           RETURNING
                              intReturnValue.
```

Parameters

hdlTemplate Input. The handle of the process template object to be refreshed.

Return type

long/ APIRET The result returned by this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The process template no longer exists or is no longer valid.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

ProcessTemplateList actions

A process template list represents a set of process templates. All process templates which are accessible through this list have the same characteristics. These characteristics are specified by a filter. Additionally, sort criteria can be applied and, after that, a threshold to restrict the number of process templates to be transferred from the execution server to the client.

The process template list definition is stored persistently.

A process template list is uniquely identified by its name, type, and owner. It can be defined for general access purposes; it is then of a *public* type. Or, it can be defined for some specific user; it is then of a *private* type.

Other lists that can be defined are process instance lists or worklists. FmcjPersistentList or PersistentList represents the common properties of all lists.

In C++, FmcjProcessTemplateList is thus a subclass of the FmcjPersistentList class and inherits all properties and methods. In Java, ProcessTemplateList is thus a subclass of the PersistentList class and inherits all properties and methods. Similarly, in C or COBOL, common implementations of functions are taken from FmcjPersistentList. That is, common functions start with the prefix FmcjPersistentList; they are also defined starting with the prefix FmcjProcessTemplateList.

The following sections describe the actions which can be applied on a process template list. See “ProcessTemplateList” on page 273 for a complete list of API calls.

QueryProcessTemplates()

This API call retrieves the primary information for all process templates characterized by the specified process template list from the MQSeries Workflow execution server (action call).

From the set of qualifying process templates, only those are retrieved, the user is authorized for. The user is authorized for a process template if the process template:

- Does not belong to any category
- Does belong to a category and the user has global process authorization or global process administration authorization or selected process authorization or selected process administration authorization for that category

The primary information that is retrieved for each process template is:

- Category
- CreationTime
- Description
- Icon
- InContainerNeeded
- LastModificationTime
- Name
- ValidFromTime

ProcessTemplateList

In C, C++, and COBOL, any process templates retrieved are appended to the supplied vector of process templates. If you want to read those process templates only which are currently included in the process template list, you have to clear the vector before you make this API call.

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProcessTemplateList
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjProcessTemplateListQueryProcessTemplates(
       FmcjProcessTemplateListHandle     hdlList,
       FmcjProcessTemplateVectorHandle * templates )
```

C++

```
APIRET QueryProcessTemplates(
       vector<FmcjProcessTemplate> & templates ) const;
```

Java

```
public abstract
ProcessTemplate[] queryProcessTemplates() throws FmcException
```

COBOL

```
         FmcjPTLQueryProcTempls.

            CALL    "FmcjProcessTemplateListQueryProcessTemplates"
                           USING
                           BY VALUE
                              hdlList
                           BY REFERENCE
                              templates
                           RETURNING
                              intReturnValue.
```

Parameters

hdlList Input. The handle of the process template list to be queried.
templates Input/Output. The vector of qualifying process templates.

Return type

long/ APIRET The result returned by this API call - see return codes below.
ProcessTemplate[]
The qualifying process templates.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.
FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.
FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.
FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_DOES_NOT_EXIST(118)
The process template list no longer exists.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples

- For a C example see “Query worklists (C)” on page 536
- For a C++ example see “Query worklists (C++)” on page 538
- For a Java example, see “Query worklists (Java)” on page 539
- For a COBOL example, see “Query worklists (COBOL)” on page 542

ProgramTemplate actions

A ProgramTemplate object represents the definition of a program within a process template.

A program template is uniquely identified by its name and the process template in which it is contained. This means that it is versioned via the containing process template.

The following sections describe the actions which can be applied to a program template. See “ProgramTemplate” on page 275 for a complete list of API calls.

Execute()

This API call requests the execution of the specified program template on the program execution server (PES) of the system where the user is logged on.

This API call can be issued synchronously or asynchronously. When called synchronously, the program should be fast enough to complete within the application wait time. When called asynchronously, a user context can be specified to correlate the response received later. Additionally, a correlation ID can be received which can be used to wait for the specific response. If a buffer to hold the correlation ID is specified, then it must initially point to FMCJ_NO_CORRELID.

Depending on the *input container access* definition of the program template, an input container must be specified for execution. Depending on the *output container access* definition, an output container can be specified to hold the values returned by program execution. If an output container is specified for the program and the output parameter is not provided, the output container defined for the program is used. When *structures from activity* is defined, containers passed can be of any type, since the program thus states that it is able to handle any container. When *structures from activity* is not defined, any containers passed must conform to the type defined in the program settings.

Initial containers returned by FmcjProcessTemplate::ProgramTemplate() do not contain any default values. When initial values are to be passed to the program, they can be set in the input or output container before making this API call.

The output container, if any, is returned on completion. The _RC data member of the output container denotes the program return code. The RC is thus available only if an output container is defined.

Specification of a priority influences OS/390 Workload management. The priority must be a value between 0 and 9.

Notes:

1. Passthrough() cannot be called from a program executed via the PES.
2. The output container is an input/output parameter. For Java, this means that it is passed as an input parameter and is the return value of the Execute() method; the input parameter is not changed.

Usage notes

- See “Action API calls” on page 122 for general information.

Authorization

Be logged on

Required connection

MQSeries Workflow program execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ProgramTemplate

COBOL fmcjvars.cpy, fmcjperf.cpy

C

```
APIRET FMC_APIENTRY FmcjProgramTemplateExecute(
       FmcjProcessTemplateHandle     hdlTemplate,
       FmcjReadWriteContainerHandle  input,
       FmcjReadWriteContainerHandle  output   )

APIRET FMC_APIENTRY FmcjProgramTemplateExecuteWithOptions(
       FmcjProcessTemplateHandle     hdlTemplate,
       unsigned long                 priority,
       FmcjReadWriteContainerHandle  input,
       FmcjReadWriteContainerHandle  output )

APIRET FMC_APIENTRY FmcjProgramTemplateExecuteAsync(
       FmcjProcessTemplateHandle     hdlTemplate,
       FmcjReadWriteContainerHandle  input,
       FmcjReadWriteContainerHandle  output,
       FmcjCorrelID *                correlID,
       char const *                  userContext )

APIRET FMC_APIENTRY FmcjProgramTemplateExecuteWithOptionsAsync(
       FmcjProcessTemplateHandle     hdlTemplate,
       unsigned long                 priority,
       FmcjReadWriteContainerHandle  input,
       FmcjReadWriteContainerHandle  output,
       FmcjCorrelID *                correlID,
       char const *                  userContext )
```

C++

```
APIRET Execute(      FmcjReadWriteContainer const * input    = 0,
                     FmcjReadWriteContainer *       output   = 0,
                     unsigned long                  priority = 0 ) const

APIRET ExecuteAsync( FmcjReadWriteContainer const * input       = 0,
                     FmcjReadWriteContainer const * output      = 0,
                     FmcjCorrelID  *                correlID    = 0,
                     string const *                 userContext = 0,
                     unsigned long                  priority    = 0) const
```

Java

```
public abstract
ReadWriteContainer execute() throws FmcException

public abstract
ReadWriteContainer execute2( ReadWriteContainer input,
                             ReadWriteContainer output,
                             long               priority )
throws FmcException
```

COBOL

```
FmcjPgTExecute.

   CALL    "FmcjProgramTemplateExecute"
                  USING
                  BY VALUE
                     hdlTemplate
                     inputValue
                     outputValue
                  BY REFERENCE
                     returnCode
                  RETURNING
                     intReturnValue.


FmcjPgTExecuteWithOptions.

   CALL    "FmcjProgramTemplateExecuteWithOptions"
                  USING
                  BY VALUE
                     hdlTemplate
                     priority
                     inputValue
                     outputValue
                  BY REFERENCE
                     returnCode
                  RETURNING
                     intReturnValue.


FmcjPgTExecuteAsync.

   CALL    "FmcjProgramTemplateExecuteAsync"
                  USING
                  BY VALUE
                     hdlTemplate
                     inputValue
                     outputValue
                  BY REFERENCE
                     correlID
                  BY VALUE
                     userContext
                  RETURNING
                     intReturnValue.


FmcjPgTExecuteWithOptionsAsync.

   CALL    "FmcjProgramTemplateExecuteWithOptionsAsync"
                  USING
                  BY VALUE
                     hdlTemplate
                     priority
                     inputValue
                     outputValue
                  BY REFERENCE
                     correlID
                  BY VALUE
                     userContext
                  RETURNING
                     intReturnValue.
```

Parameters

correlID Input/Output. If specified, contains the correlation ID by which this request can be correlated to a later response.
hdlTemplate Input. The handle of the program template object to be executed.
input Input. The input container of the program.
output Input/Output. The output container of the program.
priority Input. The priority of the program to be executed.
userContext Input. A user-defined context which can be used for correlation.

Return type
long/APIRET The return code of calling this API call - see return codes below.
ReadWriteContainer
The output container of the program.

Return codes/ FmcException
FMC_OK(0) The API call completed successfully.
FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.
FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.
FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_IMPLEMENTATION_SUPPORT_MISMATCH(32015)
The program definition for the operating system platform the PES is running on is not found.
FMC_ERROR_INVALID_CONTAINER(509)
The type of the container is incorrect or a container is expected but not passed.
FMC_ERROR_INVALID_CORRELATION_ID(506)
The specified correlation ID does not point to FMCJ_NO_CORRELID.
FMC_ERROR_INVALID_USER_CONTEXT(819)
The specified user context is longer than 254 characters.
FMC_ERROR_SUPPORT_MODE_MISMATCH(32014)
The execution mode of the program and the execution mode of the PES do not match.
FMC_ERROR_UNEXPECTED_CONTAINER(510)
A container is passed but not expected by the program.
FMC_ERROR_USER_SUPPORT_MISMATCH(32013)
The execution user of the program and the execution user of the PES do not match.
FMC_ERROR_COMMUNICATION(13)
The specified program execution server cannot be reached.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.
FMC_ERROR_XML_DOCUMENT_INVALID(1100)
The document is not a valid XML document.
FMC_ERROR_XML_NO_MQSWF_DOCUMENT(1101)
The document is not a valid MQSeries Workflow XML document.

FMC_ERROR_XML_WRONG_DATA_STRUCTURE(1103)
The type of the container is incorrect.
FMC_ERROR_XML_DATA_MEMBER_NOT_FOUND(1104)
The specified data member is not part of the container.
FMC_ERROR_XML_DATA_MEMBER_WRONG_TYPE(1105)
The type of the data member value passed is incorrect.

Service actions

A Service object represents the common aspects of MQSeries Workflow service objects.

In C++, FmcjService is the superclass of the FmcjExecutionService class and provides for all common properties and methods. In Java, Service is thus a superclass of the ExecutionService class and provides for all common properties and methods. Similarly, in C or COBOL, common implementations of functions are taken from FmcjService. That is, common functions start with the prefix FmcjService; they are also defined starting with the prefix FmcjExecutionService.

The following sections describe the actions which can be applied on a service. See "Service" on page 280 for a complete list of API calls.

Refresh()

This API call refreshes the logon status from the server (action call).

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

Logon required

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.Service
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_FMC_APIENTRY
       FmcjServiceRefresh( FmcjServiceHandle  service )

#define FmcjExecutionServiceRefresh FmcjServiceRefresh
```

C++

```
APIRET Refresh()
```

Java

```
public abstract
void refresh() throws FmcException
```

COBOL

```
        FmcjSrvRefresh.

           CALL    "FmcjServiceRefresh"
                          USING
                          BY VALUE
                             serviceValue
                          RETURNING
                             intReturnValue.
```

Parameters

service Input. A handle to the service object representing the session with an MQSeries Workflow server.

Return type

APIRET/long The return code from this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

SetPassword()

This API call allows a user's password to be changed (action call).

Note: The password is case-sensitive.

The following rules apply for specifying a password:

- You can specify a maximum of 32 characters.
- You can use any printable characters depending on your current locale.
- Do not use DBCS characters.

Note: If you intend to work in a multi-platform environment or switch between code pages, it is recommended that you use alphabetic characters, digits, and blanks only. This is because it cannot be guaranteed that special characters are available in all code pages.

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

Logon required

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.Service
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_FMC_APIENTRY
       FmcjServiceSetPassword( FmcjServiceHandle service,
                               char const *      newPassword )

#define FmcjExecutionServiceSetPassword FmcjServiceSetPassword
```

C++

```
APIRET SetPassword( string const & newPassword ) const
```

Java

```
public abstract
void   setPassword( String newPassword ) throws FmcException
```

COBOL

```
         FmcjSrvSetPassword.

            CALL    "FmcjServiceSetPassword"
                           USING
                           BY VALUE
                              serviceValue
                              newPassword
                           RETURNING
                              intReturnValue.
```

Parameters

newPassword Input. The new password to be used.

service Input. A handle to the service object representing the session with an MQSeries Workflow server.

Return type

long/ APIRET The return code from this API call - see return codes below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_USERID_UNKNOWN(10)
The user no longer exists.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_PASSWORD(12)
The password does not comply with the MQSeries Workflow syntax rules.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

UserSettings()

This API call returns all settings of the logged on user (action call).

An empty object or a null pointer is returned if no user has logged on yet via this service object.

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

Logon required

Required connection

MQSeries Workflow execution server

API interface declarations

C fmcjcrun.h

C++ fmcjprun.hxx

Service

Java com.ibm.workflow.api.Service

COBOL fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_FMC_APIENTRY
       FmcjServiceUserSettings( FmcjServiceHandle  service,
                                FmcjPersonHandle * user )

#define FmcjExecutionServiceUserSettings FmcjServiceUserSettings
```

C++

```
APIRET UserSettings( FmcjPerson & user ) const
```

Java

```
public abstract
Person userSettings() throws FmcException
```

COBOL

```
         FmcjSrvUserSettings.

            CALL    "FmcjServiceUserSettings"
                           USING
                           BY VALUE
                              serviceValue
                           BY REFERENCE
                              user
                           RETURNING
                              intReturnValue.
```

Parameters

returnCode Input/Output. The return code of calling this method - see return codes below.

service Input. A handle to the service object representing the session with an MQSeries Workflow server.

user Input/Output. The person object to contain or the address of the person handle to point to the settings of the logged on user.

Return type

APIRET The return code from this API call - see return codes below.

IDispatch*/ Person
A pointer to the person settings or the person settings of the logged on user.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Workitem actions

A Workitem object represents an activity instance assigned to a user in order to be worked on.

Other items assigned to users are process instance notifications and activity instance notifications. FmcjItem or Item represents the common properties of all items.

In C++, FmcjWorkitem is thus a subclass of the FmcjItem class and inherits all properties and methods. In Java, WorkItem is thus a subclass of the Item class and inherits all properties and methods. Similarly, in C or COBOL, common implementations of functions are taken from FmcjItem. That is, common functions start with the prefix FmcjItem; they are also defined starting with the prefix FmcjWorkitem.

A work item is uniquely identified by its object identifier.

The following diagrams provide an overview of the possible work item states and the actions which are allowed in those states, provided that the appropriate authority has been granted. Note that the actions and possible states are dependent on the process instance state, the work item is a part of.

Workitem

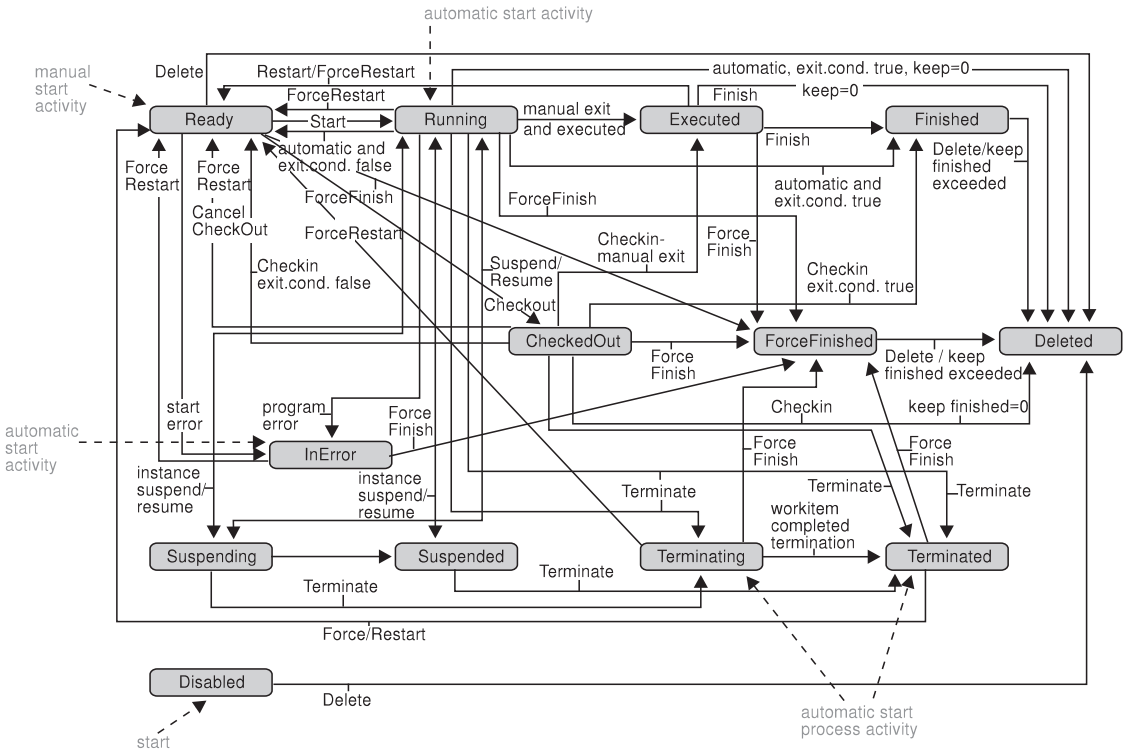


Figure 44. Work item states - process instance state running

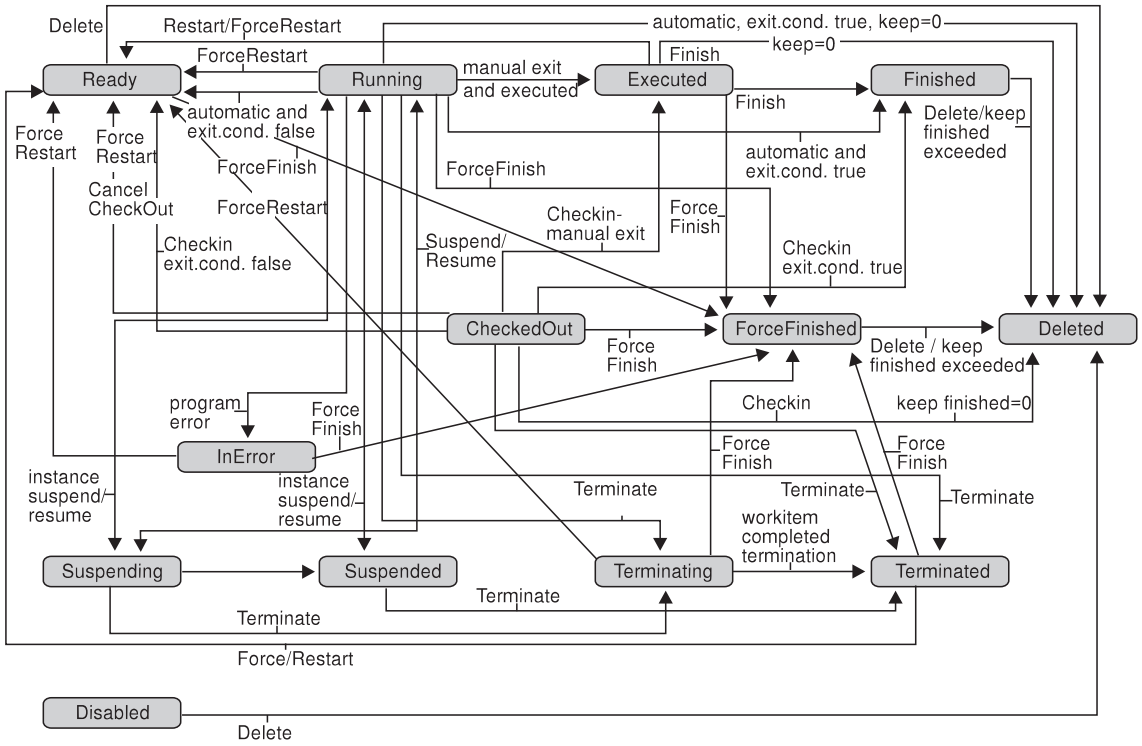


Figure 45. Work item states - process instance state suspending or suspended

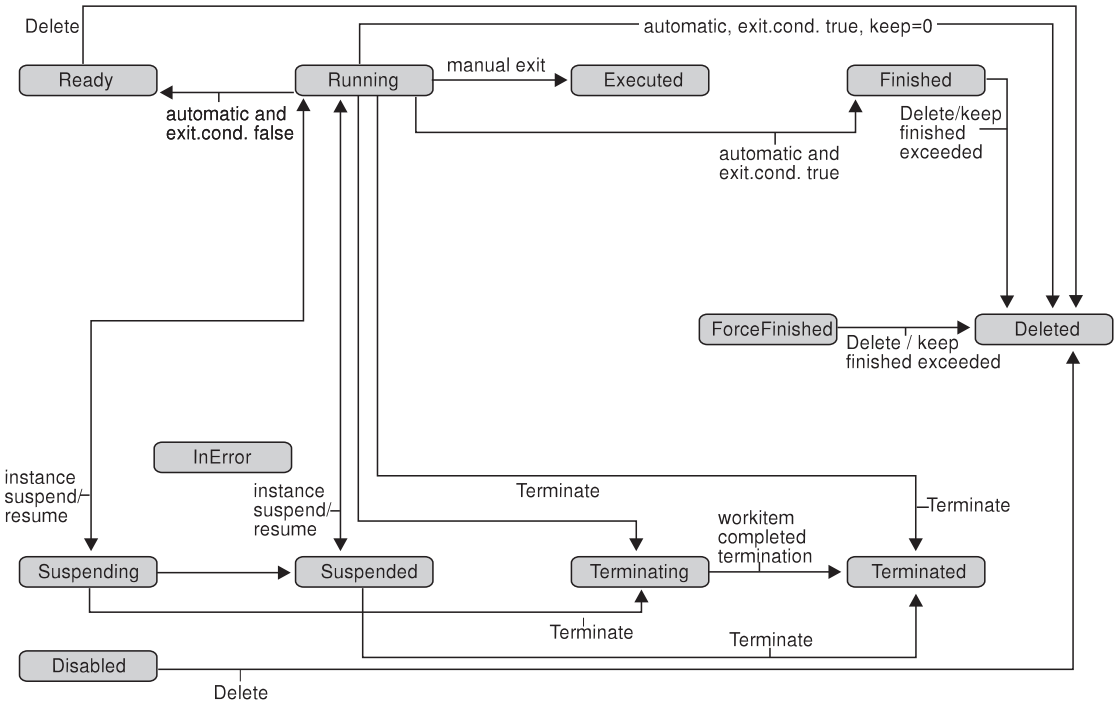


Figure 46. Work item states - process instance state terminating or terminated

The following sections describe the actions which can be applied on a work item. See "WorkItem" on page 282 for a complete list of API calls.

CancelCheckOut()

This API call cancels the checkout of the work item (action call).

The work item must have been checked out and is put into the *Ready* state. The associated process instance must be in the *Running, Suspending, Suspended,* or *Terminating* state.

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

Be the work item owner

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.WorkItem
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjWorkitemCancelCheckOut( FmcjWorkitemHandle hdlWorkitem )
```

C++

```
APIRET CancelCheckOut()
```

Java

```
public abstract
void  cancelCheckOut() throws FmcException
```

COBOL

```
        FmcjWICancelCheckOut.

           CALL    "FmcjWorkitemCancelCheckOut"
                         USING
                         BY VALUE
                            hdlWorkitem
                         RETURNING
                            intReturnValue.
```

Parameters

hdlWorkitem Input. The handle of the work item to be dealt with.

Return type

long/ APIRET The return code of calling this method - see below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The work item no longer exists.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_WRONG_STATE(120)
The work item or process instance is not in a required state.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

CheckIn()

This API call allows for the check in of a work item that was previously checked out for user processing (action call).

Checking in a work item tells MQSeries Workflow that user processing has finished and workflow processing under the control of MQSeries Workflow can continue. The return code of the user processing and, optionally, the output container values are passed back to MQSeries Workflow. As usual, these container values and the return code can be used in exit conditions to let navigation continue depending on the success of the processing and in transition conditions to indicate how to proceed.

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

Be the work item owner

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.WorkItem
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjWorkitemCheckIn( FmcjWorkitemHandle           hdlWorkitem,
                     FmcjReadWriteContainerHandle output,
                     long                         returnCode )
```

C++

```
APIRET CheckIn( FmcjReadWriteContainer const * output,
                long                           returnCode )
```

Java

```
public abstract
void   checkIn( ReadWriteContainer output,
                int                returnCode ) throws FmcException
```

COBOL

```
         FmcjWICheckIn.

            CALL    "FmcjWorkitemCheckIn"
                           USING
                           BY VALUE
                              hdlWorkitem
                              outputValue
                              returnCode
                           RETURNING
                              intReturnValue.
```

Parameters

hdlWorkitem Input. The handle of the work item to be dealt with.

output Input. A handle or pointer to the output container; can be a NULL pointer.

returnCode Input. The return code of user processing.

Return type

long/ APIRET

The return code from this API call- see below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)

A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)

The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)

The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)

The work item no longer exists.

FMC_ERROR_NOT_AUTHORIZED(119)

Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)

Not logged on.

FMC_ERROR_WRONG_STATE(120)

The work item is not checked out.

FMC_ERROR_COMMUNICATION(13)

The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)

An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

CheckOut()

This API call checks out a ready work item for user processing (action call).

The work item must processed by a program.

Checkout then means that processing is not done by MQSeries Workflow's inherent program-invocation mechanism. MQSeries Workflow assumes that processing is done by user-specific means and changes the state of the work item to *CheckedOut*.

The associated process instance must be in the *Running* state.

The caller can request program definitions for specific operating system platforms. The following enumeration types can be used to specify the requested program data.

C	FmcjWorkitemProgramRetrieval
C++	FmcjWorkitem::ProgramRetrieval
Java	com.ibm.workflow.api.WorkItemPackage.ProgramRetrieval

The enumeration constants can take the following values; it is strongly advised to use the symbolic names instead of the associated integer values.

NotSet indicates that no value is set.

C	Fmc_DP_NotSet
C++	FmcjWorkitem::NotSet
Java	ProgramRetrieval.NOT_SET
COBOL	Fmc-DP-NotSet

CommonDataOnly
returns only data common to all platforms, the description, the icon, the unattended indicator, and the input and output containers. Any platform specification is ignored.

C	Fmc_WS_CommonDataOnly
C++	FmcjWorkitem::CommonDataOnly
Java	ProgramRetrieval.COMMON_DATA_ONLY
COBOL	Fmc-WS-CommonDataOnly

SpecifiedDefinitions
returns the program definition for the specified platform. A platform must be specified.

C	Fmc_WS_SpecifiedDefinitions
C++	FmcjWorkitem::SpecifiedDefinitions
Java	ProgramRetrieval.SPECIFIED_DEFINITIONS
COBOL	Fmc-WS-SpecifiedDefs

AllDefinitions
returns all available program definitions. Any platform specification is ignored.

C	Fmc_WS_AllDefinitions
C++	FmcjWorkitem::AllDefinitions
Java	ProgramRetrieval.ALL_DEFINITIONS
COBOL	Fmc-WS-AllDefs

The following enumeration types can be used to specify the platform for which program definitions are to be retrieved.

C	FmcjImplementationDataBasis
C++	FmcjImplementationData::Basis
Java	com.ibm.workflow.api.ProgramDataPackage.Basis

The enumeration constants can take the following values; it is strongly advised to use the symbolic names instead of the associated integer values.

NotSet indicates that no value is set.

C	Fmc_DP_NotSet
C++	FmcjImplementationData::NotSpecified
Java	Basis.NOT_SPECIFIED
COBOL	Fmc-DP-NotSet

OS2 indicates that the program definition for the OS/2 platform is requested.

C	Fmc_DP_OS2
C++	FmcjImplementationData::OS2
Java	Basis.OS2
COBOL	Fmc-DP-OS2

AIX indicates that the program definition for the AIX platform is requested.

C	Fmc_DP_AIX
C++	FmcjImplementationData::AIX
Java	Basis.AIX
COBOL	Fmc-DP-AIX

HPUX indicates that the program definition for the HP-UX platform is requested.

C	Fmc_DP_HPUX
C++	FmcjImplementationData::HPUX
Java	Basis.HPUX
COBOL	Fmc-DP-HPUX

Windows95 indicates that the program definition for the Windows 95 platform is requested.

C	Fmc_DP_Windows95
C++	FmcjImplementationData::Windows95

	Java	Basis.WINDOWS_95
WindowsNT	**COBOL**	Fmc-DP-Windows95 indicates that the program definition for the Windows NT platform is requested.
	C	Fmc_DP_WindowsNT
	C++	FmcjImplementationData::WindowsNT
	Java	Basis.WINDOWS_NT
OS390	**COBOL**	Fmc-DP-WindowsNT indicates that the program definition for the OS/390 platform is requested.
	C	Fmc_DP_OS390
	C++	FmcjImplementationData::OS390
	Java	Basis.WINDOWS_OS390
Solaris	**COBOL**	Fmc-DP-OS390 indicates that the program definition for the Solaris platform is requested.
	C	Fmc_DP_Solaris
	C++	FmcjImplementationData::Solaris
	Java	Basis.Solaris
	COBOL	Fmc-DP-Solaris

For Java programs, checkOut2() additionally allows for specifying which program definitions to retrieve.

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

Be the work item owner

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.WorkItem
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjWorkitemCheckOut( FmcjWorkitemHandle                hdlWorkitem,
                      enum FmcjWorkitemProgramRetrieval requestedData,
                      enum FmcjImplementationDataBasis  platform,
                      FmcjProgramDataHandle *           programData  )
```

C++

```
APIRET CheckOut( ProgramRetrieval                requestedData,
                 FmcjImplementationData::Basis   platform,
                 FmcjProgramData &               programData  )
```

Java

```
public abstract
ReadOnlyContainer checkOut() throws FmcException

public abstract
ProgramData       checkOut2(
                  ProgramRetrieval  requestedData,
                  Basis             platform     ) throws FmcException
```

COBOL

```
        FmcjWICheckOut.

           CALL    "FmcjWorkitemCheckOut"
                         USING
                         BY VALUE
                            hdlWorkitem
                            requestedData
                            platform
                         BY REFERENCE
                            programData
                         RETURNING
                            intReturnValue.
```

Parameters

hdlWorkitem Input. The handle of the work item to be dealt with.

platform Input. The platform for which the program definition is to be returned.

programData Input/Output. The address of a handle to the program definition or the program definition object to be set.

requestedData Input. An indicator which program definitions are to be returned.

returnCode Input/Output. The return code of calling this method - see below.

Return type

APIRET The return code of calling this method - see below.

ProgramData The program definition.

ReadOnlyContainer
The input container of the work item; the container is part of the program definition. Returned for Version 2 compatibility reasons.

Return codes/ FmcException
FMC_OK(0) The API call completed successfully.
FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.
FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.
FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_CHECKOUT_NOT_POSSIBLE(503)
The work item cannot be checked out.
FMC_ERROR_DOES_NOT_EXIST(118)
The work item no longer exists.
FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_WRONG_STATE(120)
The work item or process instance is in the wrong state.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Finish()

This API call ends the execution of a manual-exit work item (action call).

The work item must be in state *Executed*, that is, must have run at least once. The work item is then put into the *Finished* state. Depending on the "delete finished items" option, it is deleted.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

Be the work item owner

Required connection

MQSeries Workflow execution server

API interface declarations

Workitem

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.WorkItem
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjWorkitemFinish( FmcjWorkitemHandle hdlWorkitem )
```

C++

```
APIRET Finish()
```

Java

```
public abstract
void   finish() throws FmcException
```

COBOL

```
         FmcjWIFinish.

            CALL    "FmcjWorkitemFinish"
                           USING
                           BY VALUE
                              hdlWorkitem
                           RETURNING
                              intReturnValue.
```

Parameters

hdlWorkitem Input. The handle of the work item to be dealt with.

Return type

long/ APIRET The return code of calling this method - see below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The work item no longer exists.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_WRONG_STATE(120)
The work item is in the wrong state.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

ForceFinish()

This API call ends the execution of a work item which is known to have completed in cases where MQSeries Workflow did not recognize this event (action call).

This situation can occur when the execution server aborted before it received the activity implementation completion message.

A work item implemented by a program must be in the states *Ready*, *Running*, *Executed*, *CheckedOut*, *InError*, *Terminating*, or *Terminated*. A work item implemented by a process must be in the states *Ready, Executed, InError*, or *Terminated*. The associated process instance must be in the states *Running*, *Suspending*, *Suspended*, or *Terminating*.

The work item is then put into the *ForceFinished* state. The exit condition is considered to be true and navigation proceeds.

Depending on the "delete finished items" option, the work item is deleted.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

Be the work item owner and one of
- Process administration authorization
- Be the process administrator
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.WorkItem
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjWorkitemForceFinish( FmcjWorkitemHandle hdlWorkitem )
```

C++

```
APIRET ForceFinish()
```

Java

```
public abstract
void   forceFinish() throws FmcException
```

COBOL

```
         FmcjWIForceFinish.

            CALL    "FmcjWorkitemForceFinish"
                          USING
                          BY VALUE
                             hdlWorkitem
                          RETURNING
                             intReturnValue.
```

Parameters

hdlWorkitem Input. The handle of the work item to be dealt with.

Return type

long/ APIRET The return code of calling this method - see below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The work item no longer exists.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_WRONG_STATE(120)
The work item is in the wrong state.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

ForceRestart()

This API call forces MQSeries Workflow to enable the restart of a work item (action call).

A work item implemented by a program must be in states *Running*, *Executed*, *CheckedOut*, *InError*, *Terminating*, or *Terminated*. A work item implemented by a process must be in states *Executed, InError*, or *Terminated*. The associated process instance must be in states *Running*, *Suspending*, or *Suspended*.

It is then reset into the *Ready* state. Note that automatic activity instances must now be started manually.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

Be the work item owner and one of
- Process administration authorization
- Be the process administrator
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.WorkItem
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjWorkitemForceRestart(
       FmcjWorkitemHandle hdlWorkitem )
```

C++

```
APIRET ForceRestart()
```

Java

```
public abstract
void   forceRestart() throws FmcException
```

COBOL

```
        FmcjWIForceRestart.

           CALL    "FmcjWorkitemForceRestart"
                          USING
                          BY VALUE
                             hdlWorkitem
                          RETURNING
                             intReturnValue.
```

Parameters

hdlWorkitem Input. The handle of the work item to be dealt with.

Return type

long/ APIRET The return code of calling this method - see below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The work item no longer exists.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_WRONG_STATE(120)
The work item or process instance is in the wrong state.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

InContainer()

This API call retrieves the input container associated with the work item from the MQSeries Workflow execution server (action call).

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

One of:

- Be the work item owner
- Work item authorization
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.WorkItem
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjWorkitemInContainer( FmcjWorkitemHandle            hdlWorkitem,
                         FmcjReadOnlyContainerHandle * input )
```

C++

```
APIRET InContainer( FmcjReadOnlyContainer & input ) const
```

Java

```
public abstract
ReadOnlyContainer inContainer() throws FmcException
```

COBOL

```
FmcjWIInCtnr.

   CALL    "FmcjWorkitemInContainer"
                  USING
                  BY VALUE
                     hdlWorkitem
                  BY REFERENCE
                     inputValue
                  RETURNING
                     intReturnValue.
```

Parameters

hdlWorkitem Input. The handle of the work item to be dealt with.
input Input/Output. The input container.

Return type

long/ APIRET The return code of calling this method - see below.
ReadOnlyContainer
The input container.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.
FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.
FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.
FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_DOES_NOT_EXIST(118)
The work item no longer exists.
FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

OutContainer()

This API call retrieves the output container associated with the work item from the MQSeries Workflow execution server (action call).

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

One of:
- Be the work item owner
- Work item authorization
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.WorkItem
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjWorkitemOutContainer( FmcjWorkitemHandle             hdlWorkitem,
                          FmcjReadWriteContainerHandle * output )
```

C++

```
APIRET OutContainer( FmcjReadWriteContainer & output ) const
```

Java

```
public abstract
ReadWriteContainer outContainer() throws FmcException
```

COBOL

```
        FmcjWIOutCtnr.

           CALL    "FmcjWorkitemOutContainer"
                          USING
                          BY VALUE
                             hdlWorkitem
                          BY REFERENCE
                             outputValue
                          RETURNING
                             intReturnValue.
```

Parameters

hdlWorkitem	Input. The handle of the work item to be dealt with.
output	Input/Output. The output container.

Return type

long/ APIRET The return code of calling this method - see below.

ReadWriteContainer
The output container.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The work item no longer exists.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

PersistentObject()

This API call retrieves the work item identified by the passed object identifier from the MQSeries Workflow execution server (action call).

The MQSeries Workflow execution server from which the work item is to be retrieved is identified by the execution service object. The transient object is then created or updated with all information - primary and secondary - of the work item.

In C++, when the work item object to be initialized is not empty, that object is destructed before the new one is assigned. In C, the application is completely responsible for the ownership of objects, that is, it is not checked whether the Work item handle already points to some object. In Java, a work item is newly created; the execution service acts as a factory.

Usage notes

- See “Action API calls” on page 122 for general information.

Authorization

One of:

- Be the work item owner

- Work item authorization
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.ExecutionService
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjWorkitemPersistentObject( FmcjExecutionServiceHandle service,
                              char const *               oid,
                              FmcjWorkitemHandle *       hdlWorkitem )
```

C++

```
APIRET PersistentObject( FmcjExecutionService const & service,
                         string const &               oid )
```

Java

```
public abstract
  WorkItem ExecutionService.persistentWorkItem( String oid )
throws FmcException
```

COBOL

```
        FmcjWIPersistentObj.

           CALL    "FmcjWorkitemPersistentObject"
                          USING
                          BY VALUE
                             serviceValue
                             oid
                          BY REFERENCE
                             hdlWorkitem
                          RETURNING
                             intReturnValue.
```

Parameters

hdlWorkitem	Input/Output. The address of the handle to the work item object to be set.
oid	Input. The object identifier of the work item to be retrieved.
service	Input. The service object representing the session with the execution server.

Return type

long/ APIRET The return code of calling this method - see below.
WorkItem The work item retrieved.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.
FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.
FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_DOES_NOT_EXIST(118)
The work item no longer exists.
FMC_ERROR_INVALID_OID(805)
The provided oid is invalid.
FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.
FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Restart()

This API call asks MQSeries Workflow to enable the restart of a work item (action call).

The work item must be in state *Executed*. It is then reset into the *Ready* state.

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

Be the work item owner

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.WorkItem
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjWorkitemRestart( FmcjWorkitemHandle hdlWorkitem )
```

C++

```
APIRET Restart()
```

Java

```
public abstract
void   restart() throws FmcException
```

COBOL

```
        FmcjWIRestart.

           CALL    "FmcjWorkitemRestart"
                          USING
                          BY VALUE
                             hdlWorkitem
                          RETURNING
                             intReturnValue.
```

Parameters

hdlWorkitem Input. The handle of the work item to be dealt with.

Return type

long/ APIRET The return code of calling this method - see below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The work item no longer exists.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_WRONG_STATE(120)
The work item is in the wrong state.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Start()

This API call starts a ready work item (action call).

The associated process instance must be in the *Running* state.

If the associated activity instance is implemented by a program, the program is started on the program execution server associated with the program.

The work item is put into the *Running* state. If the activity implementation or an associated process activity cannot be started, the work item is put into the *InError* state.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

Be the work item owner

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.WorkItem
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjWorkitemStart( FmcjWorkitemHandle hdlWorkitem )
```

C++

```
APIRET Start()
```

Java

```
public abstract
void   start() throws FmcException
```

COBOL

```
        FmcjWIStart.

           CALL    "FmcjWorkitemStart"
                          USING
                          BY VALUE
                             hdlWorkitem
                          RETURNING
                             intReturnValue.
```

Parameters

hdlWorkitem Input. The handle of the work item to be dealt with.

Return type

long/ APIRET The return code of calling this method - see below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The work item no longer exists.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_WRONG_STATE(120)
The work item or process instance is in the wrong state.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

StartTool()

This API call starts the specified support tool (action call).

The support tool must be one of the tools associated with the activity instance the work item is derived from. It is then started via the program execution agent associated with the logged-on user.

Note: A support tool can be started only via a program execution agent in the LAN environment; starting via a program execution server (in either environment) is currently not supported. Since there are only unattended processes under MQSeries Workflow for OS/390, it is not meaningful to start a support tool in this environment. The PES will simply ignore such an attempt.

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

Be the work item owner

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.WorkItem
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjWorkitemStartTool( FmcjWorkitemHandle hdlWorkitem,
                       char const *       toolName   )
```

C++

```
APIRET StartTool( string const & toolName ) const
```

Java

```
public abstract
void   startTool( String toolName ) throws FmcException
```

COBOL

```
FmcjWIStartTool.

   CALL    "FmcjWorkitemStartTool"
                  USING
                  BY VALUE
                     hdlWorkitem
                     toolName
                  RETURNING
                     intReturnValue.
```

Parameters

hdlWorkitem Input. The handle of the work item to be dealt with.
toolName Input. The support tool to be started.

Return type

long/ APIRET The return code of calling this method - see below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The work item no longer exists.

FMC_ERROR_INVALID_TOOL(129)
No tool name is provided or the specified tool is not defined for the work item.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Terminate()

This API call terminates a work item implemented by a program or process (action call).

If the work item is implemented by a program, it must be in the states *CheckedOut* or *Running* and the process instance must be in the states *Running, Suspending*, or *Suspended*. If the work item is implemented by a process, it must be in the states *Running, Suspending*, or *Suspended* and the process instance must be in the states *Running, Suspending, Suspended*, or *Terminating*.

A work item implemented by a process is terminated together with all its non-autonomous subprocesses with respect to control autonomy.

The work item is then put into the *Terminating* or *Terminated* state.

Depending on the "delete finished items" option, the work item is deleted.

When the *Terminated* state has been reached, the exit condition is considered to be false, the output container and especially the return code (_RC) are not set, and navigation ends. If not yet deleted, navigation can be explicitly continued by a user with process administration rights, that is, ForceFinish() or ForceRestart() repair actions can be called.

Usage notes

- See "Action API calls" on page 122 for general information.

Authorization

Be the work item owner

For work items implemented by a process, additionally one of:

- Process administration authority
- Be the process administrator
- Be the system administrator

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.WorkItem
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjWorkitemTerminate( FmcjWorkitemHandle hdlWorkitem )
```

C++

```
APIRET Terminate()
```

Java

```
public abstract
void   terminate() throws FmcException
```

COBOL

```
         FmcjWITerminate.

            CALL    "FmcjWorkitemTerminate"
                           USING
                           BY VALUE
                              hdlWorkitem
                           RETURNING
                              intReturnValue.
```

Parameters

hdlWorkitem Input. The handle of the work item to be terminated.

Return type

long/ APIRET The return code of calling this method - see below.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The work item no longer exists.

FMC_ERROR_NOT_AUTHORIZED(119)
Not authorized to use the API call.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_WRONG_STATE(120)
The work item or process instance is in the wrong state.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Worklist actions

A Worklist object represents a set of items, that is, a set of work items or notifications. All items which are accessible through this list have the same characteristics. These characteristics are specified by a filter. Additionally, sort criteria can be applied and, after that, a threshold to restrict the number of items to be transferred from the execution server to the client.

The worklist definition is stored persistently. The items contained in the worklist are, however, assembled dynamically when they are queried.

A worklist is uniquely identified by its name, type, and owner. It can be defined for general access purposes; it is then of a *public* type. Or, it can be defined for some specific user; it is then of a *private* type.

Other lists that can be defined are process template lists or process instance lists. FmcjPersistentList or PersistentList represents the common properties of all lists.

In C++, FmcjWorklist is thus a subclass of the FmcjPersistentList class and inherits all properties and methods. In the Java language, WorkList is thus a subclass of the PersistentList class and inherits all properties and methods. Similarly, in C or COBOL, common implementations of functions are taken from FmcjPersistentList. That is, common functions start with the prefix FmcjPersistentList; they are also defined starting with the prefix FmcjWorklist.

The following sections describe the actions which can be applied on a worklist. See “Worklist” on page 284 for a complete list of API calls.

QueryActivityInstanceNotifications()

This API call retrieves the primary information for all activity instance notifications characterized by the specified worklist from the MQSeries Workflow execution server (action call).

From the set of qualifying activity instance notifications, only those are retrieved, the user is authorized for. The user is authorized for an activity instance notification if

- He is the owner of the activity instance notification
- He has workitem authority
- He is the system administrator

The primary information that is retrieved for each activity instance notification is:

- ActivityType
- Category
- CreationTime
- Description
- Icon
- Implementation
- Kind
- LastModificationTime
- Name
- Owner
- Priority
- ProcessInstanceName
- ReceivedAs
- ReceivedTime

- StartTime
- State
- SupportTools

In C, C++, and COBOL, any activity instance notifications retrieved are appended to the supplied vector of activity instance notifications. If you want to read those activity instance notifications only which are currently included in the worklist, you have to clear the vector before you issue this API call. This means that you should set the handle to 0 in C or COBOL, or erase all elements of the vector in C++.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.WorkList
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjWorklistQueryActivityInstanceNotifications(
       FmcjWorklistHandle                              hdlList,
       FmcjActivityInstanceNotificationVectorHandle * notifications )
```

C++

```
APIRET QueryActivityInstanceNotifications(
       vector<FmcjActivityInstanceNotification> & notifications ) const
```

Java

```
public abstract
ActivityInstanceNotification[] queryActivityInstanceNotifications()
throws FmcException
```

COBOL

```
FmcjWLQueryActInstNotifs.

   CALL    "FmcjWorklistQueryActivityInstanceNotifications"
                  USING
                  BY VALUE
                     hdlList
                  BY REFERENCE
                     notifications
                  RETURNING
                     intReturnValue.
```

Parameters

hdlList Input. The handle of the worklist to be queried.

notifications Input/Output. The vector of qualifying activity instance notifications.

Return type

long/ APIRET The return code of calling this method - see below.

ActivityInstanceNotification[]
The qualifying activity instance notifications.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The worklist no longer exists.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples

- For a C example see “Query work items from a worklist (C)” on page 560
- For a C++ example see “Query work items from a worklist (C++)” on page 562
- For a Java example see “Query work items from a worklist (Java)” on page 564

QueryItems()

This API call retrieves the primary information for all items characterized by the specified worklist from the MQSeries Workflow execution server (action call).

From the set of qualifying items, only those are retrieved, the user is authorized for. The user is authorized for an item if
- He is the owner of the item
- He has workitem authority
- He is the system administrator

The primary information that is retrieved for each item is:
- Category
- CreationTime
- Description
- Icon
- Kind
- LastModificationTime
- Name
- Owner
- ProcessInstanceName
- ReceivedAs
- ReceivedTime
- StartTime
- State

If the item is an actual work item or an activity instance notification, then additional primary information is retrieved:
- ActivityType
- Implementation
- Priority
- SupportTools

In C, C++, and COBOL, any items retrieved are appended to the supplied vector of items. If you want to read those items only which are currently included in the worklist, you have to clear the vector before you issue this API call. This means that you should set the handle to 0 in C or COBOL, or erase all elements of the vector in the C++ API.

Usage notes
- See “Action API calls” on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.WorkList

COBOL fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY
FmcjWorklistQueryItems( FmcjWorklistHandle     hdlList,
                        FmcjItemVectorHandle * items )
```

C++

```
APIRET QueryItems( vector<FmcjItem> & items ) const
```

Java

```
public abstract Item[] queryItems() throws FmcException
```

COBOL

```
         FmcjWLQueryItems.

            CALL    "FmcjWorklistQueryItems"
                           USING
                           BY VALUE
                              hdlList
                           BY REFERENCE
                              items
                           RETURNING
                              intReturnValue.
```

Parameters

hdlList Input. The handle of the worklist to be queried.
items Input/Output. The vector of qualifying items.

Return type

APIRET The return code of calling this method - see below.
Item[] The qualifying items.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.
FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.
FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.
FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.
FMC_ERROR_DOES_NOT_EXIST(118)
The worklist no longer exists.
FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.
FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.
FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.
FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples
- For a C example see "Query work items from a worklist (C)" on page 560
- For a C++ example see "Query work items from a worklist (C++)" on page 562
- For a Java example see "Query work items from a worklist (Java)" on page 564

QueryProcessInstanceNotifications()

This API call retrieves the primary information for all process instance notifications characterized by the specified worklist from the MQSeries Workflow execution server (action call).

From the set of qualifying process instance notifications, only those are retrieved, the user is authorized for. The user is authorized for a process instance notification if
- He is the owner of the process instance notification
- He has workitem authority
- He is the system administrator

The primary information that is retrieved for each process instance notification is:
- Category
- CreationTime
- Description
- Icon
- Kind
- LastModificationTime
- Name
- Owner
- ProcessInstanceName
- ReceivedAs
- ReceivedTime
- StartTime
- State

In C, C++, and COBOL, any process instance notifications retrieved are appended to the supplied vector of process instance notifications. If you want to read those process instance notifications only which are currently included in the worklist, you have to clear the vector before you issue this API call. This means that you should set the handle to 0 in C or COBOL, or erase all elements of the vector in the C++ API.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.WorkList
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjWorklistQueryProcessInstanceNotifications(
       FmcjWorklistHandle                          hdlList,
       FmcjProcessInstanceNotificationVectorHandle * notifications )
```

C++

```
APIRET QueryProcessInstanceNotifications(
       vector<FmcjProcessInstanceNotification> & notifications ) const
```

Java

```
public abstract
ProcessInstanceNotification[] queryProcessInstanceNotifications()
throws FmcException
```

COBOL

```
        FmcjWLQueryProcInstNotifs.

            CALL    "FmcjWorklistQueryProcessInstanceNotifications"
                          USING
                          BY VALUE
                             hdlList
                          BY REFERENCE
                             notifications
                          RETURNING
                             intReturnValue.
```

Parameters

hdlList	Input. The handle of the worklist to be queried.
notifications	Input/Output. The vector of qualifying process instance notifications.

Return type

long/ APIRET	The return code of calling this method - see below.
ProcessInstanceNotification[]	The qualifying process instance notifications.

Return codes/ FmcException

FMC_OK(0) The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The worklist no longer exists.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples

- For a C example see "Query work items from a worklist (C)" on page 560
- For a C++ example see "Query work items from a worklist (C++)" on page 562
- For a Java example see "Query work items from a worklist (Java)" on page 564

QueryWorkitems()

This API call retrieves the primary information for all work items characterized by the specified worklist from the MQSeries Workflow execution server (action call).

From the set of qualifying work items, only those are retrieved, the user is authorized for. The user is authorized for a work item if

- He is the owner of the work item
- He has workitem authority
- He is the system administrator

The primary information that is retrieved for each work item is:

- ActivityType
- Category
- CreationTime
- Description
- Icon
- Implementation
- Kind
- LastModificationTime
- Name
- Owner
- Priority
- ProcessInstanceName
- ReceivedAs

- ReceivedTime
- StartTime
- State
- SupportTools

In C, C++, and COBOL, any work items retrieved are appended to the supplied vector of work items. If you want to read those work items only which are currently included in the worklist, you have to clear the vector before you issue this API call. This means that you should set the handle to 0 in C or COBOL, or erase all elements of the vector in the C++ API.

Usage notes
- See "Action API calls" on page 122 for general information.

Authorization

None

Required connection

MQSeries Workflow execution server

API interface declarations

C	fmcjcrun.h
C++	fmcjprun.hxx
Java	com.ibm.workflow.api.WorkList
COBOL	fmcvars.cpy, fmcperf.cpy

C

```
APIRET FMC_APIENTRY FmcjWorklistQueryWorkitems(
       FmcjWorklistHandle         hdlList,
       FmcjWorkitemVectorHandle * workitems )
```

C++

```
APIRET QueryWorkitems( vector<FmcjWorkitem> & workitems ) const
```

Java

```
public abstract
WorkItem[] queryWorkItems() throws FmcException
```

COBOL

```
FmcjWLQueryWorkitems.

   CALL    "FmcjWorklistQueryWorkitems"
                  USING
                  BY VALUE
                     hdlList
                  BY REFERENCE
                     workitems
                  RETURNING
                     intReturnValue.
```

Parameters

hdlList	Input. The handle of the worklist to be queried.
workitems	Input/Output. The vector of qualifying work items.

Return type

long/ APIRET	The return code of calling this method - see below.
WorkItem[]	The qualifying work items.

Return codes/ FmcException

FMC_OK(0)
The API call completed successfully.

FMC_ERROR(1)
A parameter references an undefined location. For example, the address of a handle is 0.

FMC_ERROR_EMPTY(122)
The object has not yet been read from the database, that is, does not yet represent a persistent one.

FMC_ERROR_INVALID_HANDLE(130)
The handle provided is incorrect; it is 0 or it is not pointing to an object of the requested type.

FMC_ERROR_DOES_NOT_EXIST(118)
The worklist no longer exists.

FMC_ERROR_NOT_LOGGED_ON(106)
Not logged on.

FMC_ERROR_COMMUNICATION(13)
The specified server cannot be reached; the server to which the connection should be established is not defined in your profile.

FMC_ERROR_INTERNAL(100)
An MQSeries Workflow internal error has occurred. Contact your IBM representative.

FMC_ERROR_MESSAGE_FORMAT(103)
An internal message format error. Contact your IBM representative.

FMC_ERROR_TIMEOUT(14)
Timeout has occurred.

Examples

- For a C example see “Query work items from a worklist (C)” on page 560
- For a C++ example see “Query work items from a worklist (C++)” on page 562
- For a Java example see “Query work items from a worklist (Java)” on page 564

Chapter 6. Examples

The following samples are provided in InstHLQ.SFMCSRC:

FMCHSCFA C Full API sample (native OS/390)

FMCHSCCA C Container API sample (CICS and IMS)

FMCHSCBF COBOL Full API sample (native OS/390)

FMCHSCBC COBOL Container API sample (IMS)

FMCHSCBN COBOL Container API sample (CICS)

In addition, the following sections illustrate examples for:

- Creating persistent lists, such as process instances
- Querying persistent lists, such as process instances
- Querying a set of objects, such as process instances and work items
- Programming an activity implementation (executable)

How to create persistent lists

The following examples show how to create a persistent list, that is, a persistent view of a set of objects. They define a view of process instances. Other possible lists to define are process template lists or worklists.

Examples

Create a process instance list (C)

```
#include <stdio.h>
#include <fmcjcrun.h>                  /* MQ Workflow Runtime API */
int main()
{
  APIRET                            rc           = FMC_OK;
  FmcjExecutionServiceHandle        service      = 0;
  FmcjProcessInstanceListHandle     instanceList = 0;
  unsigned long                     threshold    = 10;
  int                               enumValue    = 0;
  char name[50]  = "MyTenInstances";
  char desc[50]   = "This list contains no more than 10 instances";

   FmcjGlobalConnect();
   /* logon */
  rc= FmcjExecutionServiceAllocate( &service );
  if (rc != FMC_OK)
  {
    printf("Service object could not be allocated - rc: %u%\n",rc);
    return -1;
  }
  rc= FmcjExecutionServiceLogon( service,
                                 "USERID", "password",
                                 Fmc_SM_Default, Fmc_SA_NotSet
                               );
  if (rc != FMC_OK)
  {
    printf("Logon failed - rc: %u%\n",rc);
    FmcjExecutionServiceDeallocate( &service );
    return -1;
  }
 /* create a process instance list */
 rc = FmcjExecutionServiceCreateProcessInstanceList(
                          service,
                          name,
                          Fmc_LT_Private,
                          "USERID",
                          desc,
                          FmcjNoFilter,
                          FmcjNoSortCriteria,
                          &threshold,
                          &instanceList );
  if ( rc != FMC_OK)
    printf( "CreateProcessInstanceList returns: %u%\n",rc );
  else
    printf( "CreateProcessInstanceList okay\n" );

  FmcjExecutionServiceLogoff( service );
  FmcjExecutionServiceDeallocate( &service );
  FmcjGlobalDisconnect();
  return 0;
}
```

Figure 47. Sample C program to create a process instance list

Create a process instance list (C++)

```
#include <iomanip.h>
#include <bool.h>                       // bool
#include <fmcjstr.hxx>                  // string
#include <vector.h>                     // vector
#include <fmcjprun.hxx>                 // MQ Workflow Runtime API
int main()
{
  FmcjGlobal::Connect();

  // logon
  FmcjExecutionService service;
  APIRET rc = service.Logon("USERID", "password");
  if ( rc != FMC_OK )
  {
    cout << "Logon failed, - rc: " << rc << endl;
    return -1;
  }

  // create a process instance list

  FmcjProcessInstanceList instanceList;
  string           name  ("MyTenInstances");
  string           desc  ("List contains no more than 10 instances");
  string           onwer ("USERID");
  unsigned long    threshold= 10;


  rc = service.CreateProcessInstanceList(
                    name,
                    FmcjPersistentList::Private,
                    &owner,
                    &desc,
                    FmcjNoFilter,
                    FmcjNoSortCriteria,
                    &threshold,
                    instanceList );
  if ( rc != FMC_OK)
     cout << "CreateProcessInstanceList returns: " << rc << endl;
  else
     cout << "CreateProcessInstanceList okay" << endl;

  service.Logoff();

  FmcjGlobal::Disconnect();
  return 0;
}
```

Figure 48. Sample C++ program to create a process instance list

Examples

Create a process instance list (Java)

```
import com.ibm.workflow.api.*;
import com.ibm.workflow.api.ServicePackage.*;
import com.ibm.workflow.api.PersistentListPackage.*;

public class CreateProcInstList
{
  public static void main(String[] args)
  {
    // Check the arguments. The first argument is the name of the MQSeries
    // Workflow agent the client will connect to. The second argument defines
    // the locator policy the client will use when trying to contact the agent.
    // The third/fourth argument define the userid/password, which, if not
    // specified, default to USERID and password

    if ((args.length < 2 ) || (args.length > 4 ))
    {
      System.out.println("Usage:");
      System.out.println("java CreateProcessInstanceList
                                  <agent> <LOC|RMI|OSA|IOR|COS>
                                  [userid] [password]");
      System.exit(0);
    }
try
    {
      // An agent bean representing an MQSeries Workflow domain
      String userid = "USERID";
      String passwd = "password";
      Agent agent = new Agent();
      // Parse the command line and set the locator to be used to
      // communicate with the agent.
      if      (args[1].equalsIgnoreCase("LOC"))
      {
        agent.setLocator(Agent.LOC_LOCATOR);
      }
      else if (args[1].equalsIgnoreCase("RMI"))
      {
        agent.setLocator(Agent.RMI_LOCATOR);
      }
      else if (args[1].equalsIgnoreCase("OSA"))
      {
        agent.setLocator(Agent.OSA_LOCATOR);
      }
      else if (args[1].equalsIgnoreCase("IOR"))
      {
        agent.setLocator(Agent.IOR_LOCATOR);
      }
      else if (args[1].equalsIgnoreCase("COS"))
      {
        agent.setLocator(Agent.COS_LOCATOR);
      }
      else
      {
        System.out.println("Invalid locator policy: " + args[1]);
        System.exit(0);
      }

      if (args.length >=3 ) userid = args[2].toUpperCase();
      if (args.length >=4 ) passwd = args[3];
```

Figure 49. Sample Java program to create a process instance list (Part 1 of 3)

```
// Set the name of the Agent to be contacted. Setting the name
// automatically instructs the agent bean to contact the Agent using
// the current locator policy. For this reason the 'setLocator' must be
// called before 'setName' is invoked. If the agent bean cannot contact
// the Agent, it will raise a java.beans.PropertyVetoException instead
// of returning from the 'setName' call.
agent.setName(args[0]);

// Locate the default execution service in the system group named
// 'SYS_GRP' and the system named 'FMCSYS'. This call intentionally
// always returns successful (to prevent intrusion attempts which guess
// at service names until they find a valid one). Of course, only using
// a valid systemgroup and/or system name will return an ExecutionService
// which can be used to log on.
ExecutionService service = agent.locate("", "");


// Log on to the execution service. If the UserID and/or the password is
// invalid, an FmcException will be thrown.
service.logon(userid, passwd);
System.out.println("Logon successful");

String ListName      ="MyTenInstances";
String ListDesc      = "List contains no more than 10 instances";
String ListFilter    = "";
String ListSort      = "";
int    ListThreshold = 10;


try
{
  service.createProcessInstanceList( ListName, TypeOfList.PRIVATE,
                                     userid  , ListDesc, ListFilter,
                                     ListSort, ListThreshold);
  System.out.println("Private ProcessInstanceList created successfully");
}
catch(FmcException e)
{
   if ( e.rc == FmcException.FMC_ERROR_NOT_UNIQUE )
   {
     System.out.println("ProcessInstanceList: '" + ListName +
                        "' already exists");
   }
}

finally
{
   // Logoff from the execution service. This (like any other remote call)
   // may raise an FmcException indicating a communication failure.
   service.logoff();

   System.out.println("Logoff successful");
}
}
```

Figure 49. Sample Java program to create a process instance list (Part 2 of 3)

Examples

```
catch(FmcException e)
    {
      // Catch and report details about the FmcException
      System.out.println("FmcException occured");
      System.out.println("  RC         : " + e.rc);
      System.out.println("  Origin     : " + e.origin);
      System.out.println("  MessageText: " + e.messageText);
      System.out.println("  Exception  : " + e.getMessage());
      System.out.println("  Parameters : ");
      for ( int i = 0; i < e.parameters.length ; i++)
      {
        System.out.println("    " + e.parameters[i] );
      }
      System.out.println("  StackTrace : ");
      e.printStackTrace();
    }

catch(Exception e)
    {
      // Catch and report any exception that occurred.
      e.printStackTrace();
    }

    System.exit(0);
  }
}
```

Figure 49. Sample Java program to create a process instance list (Part 3 of 3)

Create a process instance list (COBOL)

```
 IDENTIFICATION DIVISION.
 PROGRAM-ID. "VECTOR".

 DATA DIVISION.

   WORKING-STORAGE SECTION.

   COPY fmcvars.
   COPY fmcconst.
   COPY fmcrcs.

   01 localUserID   PIC X(30) VALUE z"USERID".
   01 localPassword PIC X(30) VALUE z"PASSWORD".
   01 listName      PIC X(50) VALUE z"MyTenInstances".
   01 desc          PIC X(50)
         VALUE z"This list contains no more than 10 instances".

   LINKAGE SECTION.

   01 retCode            PIC S9(9) BINARY.

 PROCEDURE DIVISION USING retCode.

      PERFORM FmcjGlobalConnect.

* logon
      PERFORM FmcjESAllocate.
      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "Service object could not be allocated"
         DISPLAY "rc: " retCode
         MOVE -1 TO retCode
         GOBACK
      END-IF

      CALL "SETADDR" USING localUserId userId.
      CALL "SETADDR" USING localPassword passwordValue.
      MOVE Fmc-SM-Default TO sessionMode.
      MOVE Fmc-SA-Reset TO absenceIndicator.
      PERFORM FmcjESLogon.

      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "Logon failed - rc: " retCode
         PERFORM FmcjESDeallocate
         MOVE -1 TO retCode
         GOBACK
      END-IF

* create a process instance list
      CALL "SETADDR" USING listName name.
      CALL "SETADDR" USING localUserID ownerValue.
      CALL "SETADDR" USING desc description.
      CALL "SETADDR" USING FmcjNoFilter filter.
      CALL "SETADDR" USING FmcjNoSortCriteria sortCriteria.
      MOVE FmcjNoThreshold TO threshold.
      MOVE Fmc-LT-Private TO typeValue.
      PERFORM FmcjESCreateProcInstList.
```

Figure 50. Sample COBOL program to create a process instance list (via PERFORM) (Part 1 of 2)

Examples

```
MOVE intReturnValue TO retCode
IF retCode NOT = FMC-OK
   DISPLAY "CreateProcessInstanceList returns - rc: "
   DISPLAY retCode
ELSE
   DISPLAY "CreateProcessInstanceList okay"
END-IF

PERFORM FmcjESLogoff.
PERFORM FmcjESDeallocate.
PERFORM FmcjGlobalDisconnect.
MOVE FMC-OK TO retCode.
GOBACK.

COPY fmcperf.
```

Figure 50. Sample COBOL program to create a process instance list (via PERFORM) (Part 2 of 2)

```
 IDENTIFICATION DIVISION.
 PROGRAM-ID. "VECTOR".

 DATA DIVISION.

   WORKING-STORAGE SECTION.

   COPY fmcvars.
   COPY fmcconst.
   COPY fmcrcs.

   01 localUserID   PIC X(30) VALUE z"USERID".
   01 localPassword PIC X(30) VALUE z"PASSWORD".
   01 listName      PIC X(50) VALUE z"MyTenInstances".
   01 desc          PIC X(50)
         VALUE z"This list contains no more than 10 instances".

   LINKAGE SECTION.

   01 retCode            PIC S9(9) BINARY.

 PROCEDURE DIVISION USING retCode.

      CALL "FmcjGlobalConnect".
* logon
      CALL "FmcjExecutionServiceAllocate"
         USING BY REFERENCE serviceValue
         RETURNING intReturnValue.
      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "Service object could not be allocated"
         DISPLAY "rc: " retCode
         MOVE -1 TO retCode
         GOBACK
      END-IF

      CALL "SETADDR" USING localUserId userId.
      CALL "SETADDR" USING localPassword passwordValue.
      CALL "FmcjExecutionServiceLogon"
         USING BY VALUE serviceValue
                        userID
                        passwordValue
                        Fmc-SM-Default
                        Fmc-SA-Reset
         RETURNING intReturnValue.

      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "Logon failed - rc: " retCode
         CALL "FmcjExecutionServiceDeallocate"
            USING BY REFERENCE serviceValue
            RETURNING intReturnValue
         MOVE -1 TO retCode
         GOBACK
      END-IF
```

Figure 51. Sample COBOL program to create a process instance list (via CALL) (Part 1 of 2)

Examples

```
* create a process instance list
      CALL "SETADDR" USING listName name.
      CALL "SETADDR" USING localUserID ownerValue.
      CALL "SETADDR" USING desc description.
      CALL "SETADDR" USING FmcjNoFilter filter.
      CALL "SETADDR" USING FmcjNoSortCriteria sortCriteria.
      CALL "FmcjExecutionServiceCreateProcessInstanceList"
         USING BY VALUE serviceValue
                        name
                        Fmc-LT-Private
                        ownerValue
                        description
                        filter
                        sortCriteria
                        FmcjNoThreshold
                     BY REFERENCE
                        newList
                     RETURNING
                        intReturnValue.

      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "CreateProcessInstanceList returns - rc: "
         DISPLAY retCode
      ELSE
         DISPLAY "CreateProcessInstanceList okay"
      END-IF

      CALL "FmcjExecutionServiceLogoff"
         USING BY VALUE serviceValue
         RETURNING intReturnValue.
      CALL "FmcjExecutionServiceDeallocate"
         USING BY REFERENCE serviceValue
         RETURNING intReturnValue.
      CALL "FmcjGlobalDisconnect".
      MOVE FMC-OK TO retCode.
      GOBACK.
```

Figure 51. Sample COBOL program to create a process instance list (via CALL) (Part 2 of 2)

How to query persistent lists

The following examples show how to retrieve persistent lists from the MQSeries Workflow execution server and how to query the characteristics of a list. They use worklists as example. Other possible lists to query are process template lists or process instance lists.

Examples

Query worklists (C)

```
#include <stdio.h>
#include <memory.h>
#include <fmcjcrun.h>                  /* MQ Workflow Runtime API */
int main()
{
  APIRET                        rc           = FMC_OK;
  FmcjExecutionServiceHandle    service      = 0;
  FmcjWorklistHandle            worklist     = 0;
  FmcjWorklistVectorHandle      lists        = 0;
  unsigned long                 numWList     = 0;
  unsigned long                 i            = 0;
  unsigned long                 enumValue    = 0;
  char                          tInfo[4096+1]= "";


  FmcjGlobalConnect();

  /* logon */
  rc= FmcjExecutionServiceAllocate( &service );
  if (rc != FMC_OK)
  {
    printf("Service object could not be allocated - rc: %u%\n",rc);
    return -1;
  }
  rc= FmcjExecutionServiceLogon( service,
                                 "USERID", "password",
                                 Fmc_SM_Default, Fmc_SA_NotSet
                               );
  if (rc != FMC_OK)
  {
    printf("Logon failed - rc: %u%\n",rc);
    FmcjExecutionServiceDeallocate( &service );
    return -1;
  }


  /* query worklists  */
  rc = FmcjExecutionServiceQueryWorklists( service, &lists );
  if ( rc != FMC_OK)
     printf( "QueryWorklists() returns: %u%\n",rc );
  else
     printf( "QueryWorklists() returns okay\n" );


  if (rc == FMC_OK)
  {
    numWList= FmcjWorklistVectorSize(lists);
    printf ("Number of worklists returned : %u\n", numWList);
    for( i=1; i<= numWList; i++ )
    {
      worklist= FmcjWorklistVectorNextElement(lists);
      FmcjWorklistName( worklist, tInfo, 4097 );
      printf("- Name                          : %s\n",tInfo);
```

Figure 52. Sample C program to query worklists (Part 1 of 2)

```
      enumValue= FmcjWorklistType(worklist);
      if ( enumValue == Fmc_LT_Private )
        printf("- Type                          : %s\n","private");
      if ( enumValue == Fmc_LT_Public )
        printf("- Type                          : %s\n","public");

      FmcjWorklistOwnerOfList( worklist, tInfo, 4097 );
      printf("- OwnerOfList                   : %s\n",tInfo);
      printf("- OwnerOfList is null ?         : %u\n",
               FmcjWorklistOwnerOfListIsNull(worklist) );


      FmcjWorklistDescription( worklist, tInfo, 4097 );
      printf("- Description                   : %s\n",tInfo);
      printf("- Description is null ?         : %u\n",
               FmcjWorklistDescriptionIsNull(worklist) );


      FmcjWorklistFilter( worklist, tInfo, 4097 );
      printf("- Filter                        : %s\n",tInfo);
      printf("- Filter is null ?              : %u\n",
               FmcjWorklistFilterIsNull(worklist) );


      FmcjWorklistSortCriteria( worklist, tInfo, 4097 );
      printf("- SortCriteria                  : %s\n",tInfo);
      printf("- SortCriteria is null ?        : %u\n",
               FmcjWorklistSortCriteriaIsNull(worklist) );


      printf("- Threshold                     : %u\n",
               FmcjWorklistThreshold(worklist) );
      printf("- Threshold is null ?           : %u\n",
               FmcjWorklistThresholdIsNull(worklist) );
                                 /* deallocate just read object  */
      FmcjWorklistDeallocate(&worklist);
    }
    FmcjWorklistVectorDeallocate(&lists);
  }


  FmcjExecutionServiceLogoff( service );
  FmcjExecutionServiceDeallocate( &service );

  FmcjGlobalDisconnect();
  return 0;
}
```

Figure 52. Sample C program to query worklists (Part 2 of 2)

Examples

Query worklists (C++)

```
#include <iomanip.h>
#include <bool.h>                       // bool
#include <fmcjstr.hxx>                  // string
#include <vector.h>                     // vector
#include <fmcjprun.hxx>                 // MQ Workflow Runtime API
int main()
{
  FmcjGlobal::Connect();

  // logon
  FmcjExecutionService service;
  APIRET rc = service.Logon("USERID", "password");
  if ( rc != FMC_OK )
  {
    cout << "Logon failed, - rc: " << rc << endl;
    return -1;
  }
  // query worklists

  vector<FmcjWorklist> lists;
  FmcjWorklist         worklist;
  rc = service.QueryWorklists( lists );
  if ( rc != FMC_OK)
     cout << "QueryWorklists() returns: " << rc << endl;
  else
     cout << "QueryWorklists returns okay" << endl;
  if (rc == FMC_OK)
  {
    unsigned int numWList= lists.size();
    cout << "Number of worklists returned : " << numWList << endl;
    for( unsigned long i=0; i< numWList; i++ )
    {
      worklist= lists[i];
      cout << "Name              : " << worklist.Name()              << endl;
      cout << "Type              : " <<
              ((worklist.Type() == FmcjPersistentList::Private) ? "private" :
               (worklist.Type() == FmcjPersistentList::Public)  ? "public"  :
               "not set" )           << endl;
     cout << "Owner             : " << worklist.OwnerOfList()       << endl;
      cout << "Owner null ?      : " << worklist.OwnerOfListIsNull() << endl;
      cout << "Description       : " << worklist.Description()       << endl;
      cout << "Description null ?: " << worklist.DescriptionIsNull() << endl;
     cout << "Filter            : " << worklist.Filter()            << endl;
      cout << "Filter null ?     : " << worklist.FilterIsNull()      << endl;
      cout << "SortCriteria      : " << worklist.SortCriteria()      << endl;
      cout << "SortCriteria null?: " << worklist.SortCriteriaIsNull()<< endl;
      cout << "Threshold         : " << worklist.Threshold()         << endl;
      cout << "Threshold null ?  : " << worklist.ThresholdIsNull()   << endl;
      cout << endl;     }     cout << endl;   }
  rc = service.Logoff();
  FmcjGlobal::Disconnect();
  return 0;
}
```

Figure 53. Sample C++ program to query worklists

Query worklists (Java)

```
import com.ibm.workflow.api.*;
import com.ibm.workflow.api.ServicePackage.*;
import com.ibm.workflow.api.PersistentListPackage.*;

public class QueryWorkLists
{
  public static void main(String[] args)
  {
    // Check the arguments. The first argument is the name of the MQSeries
    // Workflow agent the client will connect to. The second argument defines
    // the locator policy the client will use when trying to contact the agent.
    // The third/fourth argument define the userid/password, which, if not
    // specified, default to USERID and password
    //
    if ((args.length < 2 ) || (args.length > 4 ))
    {
      System.out.println("Usage:");
      System.out.println("java QueryWorkLists [userid] [password]");
      System.exit(0);
    }


    try
    {
      // An agent bean representing an MQSeries Workflow domain
      String userid = "USERID";
      String passwd = "password";
      Agent agent = new Agent();

      // Parse the command line and set the locator to be used to
      // communicate with the agent.
      if      (args[1].equalsIgnoreCase("LOC"))
      {
        agent.setLocator(Agent.LOC_LOCATOR);
      }
      else if (args[1].equalsIgnoreCase("RMI"))
      {
        agent.setLocator(Agent.RMI_LOCATOR);
      }
      else if (args[1].equalsIgnoreCase("OSA"))
      {
        agent.setLocator(Agent.OSA_LOCATOR);
      }
      else if (args[1].equalsIgnoreCase("IOR"))
      {
        agent.setLocator(Agent.IOR_LOCATOR);
      }
      else if (args[1].equalsIgnoreCase("COS"))
      {
        agent.setLocator(Agent.COS_LOCATOR);
      }
      else
      {
        System.out.println("Invalid locator policy: " + args[1]);
        System.exit(0);
      }
```

Figure 54. Sample Java program to query worklists (Part 1 of 3)

Examples

```
      if (args.length >=3 ) userid = args[2].toUpperCase();
      if (args.length >=4 ) passwd = args[3];

      // Set the name of the Agent to be contacted. Setting the name
      // automatically instructs the agent bean to contact the Agent using
      // the current locator policy. For this reason the 'setLocator' must be
      // called before 'setName' is invoked. If the agent bean cannot contact
      // the Agent, it will raise a java.beans.PropertyVetoException instead
      // of returning from the 'setName' call.
      agent.setName(args[0]);


 // Locate the default execution service in the system group named
      // 'SYS_GRP' and the system named 'FMCSYS'. This call intentionally
      // always returns successful (to prevent intrusion attempts which guess
      // at service names until they find a valid one). Of course, only using
      // a valid systemgroup and/or system name will return an ExecutionService
      // which can be used to log on.
      ExecutionService service = agent.locate("", "");

      // Log on to the execution service. If the UserID and/or the password is
      // invalid, an FmcException will be thrown.

      // do a forced logon
      service.logon2(userid, passwd, SessionMode.PRESENT_HERE,
                     AbsenceIndicator.LEAVE );
      System.out.println("Logon successful");


      // Query the set of worklists the logged on user can access.
      WorkList[] worklists = service.queryWorkLists();

      if (worklists.length == 0)
      {
        System.out.println("  No worklist found");
      }
      else
      {
        System.out.println("  Number of worklists returned: " + worklists.length
);


        // Iterate over the worklists, printing out their names.
        for (int ndx = 0; ndx < worklists.length; ndx++)
        {
          System.out.println("     Name               :" + worklists[ndx].name());

          if (worklists[ndx].type() == TypeOfList.PUBLIC )
          {
            System.out.println("     Type               :Public " );
          }
          else if (worklists[ndx].type() == TypeOfList.PRIVATE )
          {
            System.out.println("     Type               :Private" );
          }
          else
          {
            System.out.println("     Type               :NotSet " );
          }
```

Figure 54. Sample Java program to query worklists (Part 2 of 3)

```
          System.out.println("    Owner             :" + worklists[ndx].ownerOfList());
          System.out.println("    Description       :"+ worklists[ndx].description());
          System.out.println("    Filter            :"+ worklists[ndx].filter());
          System.out.println("    SortCriteria      :"+ worklists[ndx].sortCriteria());
          System.out.println("    Threshold         :"+ worklists[ndx].threshold());
          System.out.println("    ");
        }

      }/* End if*/


      // Logoff from the execution service. This (like any other remote call)
      // may raise an FmcException indicating a communication failure.
      service.logoff();

      System.out.println("Logoff successful");
    }


catch(FmcException e)
    {
      // Catch and report details about the FmcException
      System.out.println("FmcException occured");
      System.out.println("  RC         : " + e.rc);
      System.out.println("  Origin     : " + e.origin);
      System.out.println("  MessageText: " + e.messageText);
      System.out.println("  Exception  : " + e.getMessage());
      System.out.println("  Parameters : ");
      for ( int i = 0; i < e.parameters.length ; i++)
      {
        System.out.println("    " + e.parameters[i] );
      }
      System.out.println("  StackTrace : ");
      e.printStackTrace();
    }


 catch(Exception e)
    {
      // Catch and report any exception that occurred.
      e.printStackTrace();
    }

    System.exit(0);
  }
}
```

Figure 54. Sample Java program to query worklists (Part 3 of 3)

Examples

Query worklists (COBOL)

```
 IDENTIFICATION DIVISION.
 PROGRAM-ID. "QUERYWL".

 DATA DIVISION.

   WORKING-STORAGE SECTION.

   COPY fmcvars.
   COPY fmcconst.
   COPY fmcrcs.

   01 localUserID   PIC X(30) VALUE z"USERID".
   01 localPassword PIC X(30) VALUE z"PASSWORD".
   01 numWList      PIC 9(9) BINARY VALUE 0.
   01 tInfo         PIC X(4097).
   01 i             PIC 9(9) BINARY VALUE 0.

   LINKAGE SECTION.

   01 retCode            PIC S9(9) BINARY.

 PROCEDURE DIVISION USING retCode.

      PERFORM FmcjGlobalConnect.

* logon
      PERFORM FmcjESAllocate.
      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "Service object could not be allocated"
         DISPLAY "rc: " retCode
         MOVE -1 TO retCode
         GOBACK
      END-IF

      CALL "SETADDR" USING localUserId userId.
      CALL "SETADDR" USING localPassword passwordValue.
      MOVE Fmc-SM-Default TO sessionMode.
      MOVE Fmc-SA-Reset TO absenceIndicator.
      PERFORM FmcjESLogon.

      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "Logon failed - rc: " retCode
         PERFORM FmcjESDeallocate
         MOVE -1 TO retCode
         GOBACK
      END-IF

* query worklists
      PERFORM FmcjESQueryWorklists.
      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "QueryWorklists returns - rc: " retCode
      ELSE
         DISPLAY "QueryWorklists returns okay"
      END-IF
```

Figure 55. Sample COBOL program to query worklists (via PERFORM) (Part 1 of 3)

```
IF retCode = FMC-OK
   SET hdlVector TO lists
   PERFORM FmcjWLVectorSize
   MOVE ulongReturnValue TO numWList
   DISPLAY "Number of worklists returned : " numWList
   PERFORM VARYING i FROM 1 BY 1 UNTIL i >= numWList
      PERFORM FmcjWLVectorNextElement
      SET hdlList TO FmcjWLHandleReturnValue
      MOVE 4097 TO bufferLength
      CALL "SETADDR" USING tInfo listNameBuffer
      PERFORM FmcjWLName
      DISPLAY "- Name               : " tInfo
      PERFORM FmcjWLType
      IF intReturnValue = Fmc-LT-Private
         DISPLAY "- Type               : private"
      END-IF
      IF intReturnValue = Fmc-LT-Public
         DISPLAY "- Type               : public"
      END-IF
      CALL "SETADDR" USING tInfo userIdBuffer
      PERFORM FmcjWLOwnerOfList
      DISPLAY "- OwnerOfList        : " tInfo
      PERFORM FmcjWLOwnerOfListIsNull
      IF boolReturnValue = 0
         DISPLAY "- OwnerOfList is null ? : false"
      ELSE
         DISPLAY "- OwnerOfList is null ? : true"
      END-IF
      CALL "SETADDR" USING tInfo descriptionBuffer
      PERFORM FmcjWLDescription
      DISPLAY "- Description        : " tInfo
      PERFORM FmcjWLDescriptionIsNull
      IF boolReturnValue = 0
         DISPLAY "- Description is null ? : false"
      ELSE
         DISPLAY "- Description is null ? : true"
      END-IF
      CALL "SETADDR" USING tInfo filterBuffer
      PERFORM FmcjWLFilter
      DISPLAY "- Filter             : " tInfo
      PERFORM FmcjWLFilterIsNull
      IF boolReturnValue = 0
         DISPLAY "- Filter is null ?      : false"
      ELSE
         DISPLAY "- Filter is null ?      : true"
      END-IF
      CALL "SETADDR" USING tInfo sortCriteriaBuffer
      PERFORM FmcjWLSortCriteria
      DISPLAY "- SortCriteria       : " tInfo
      PERFORM FmcjWLSortCriteriaIsNull
      IF boolReturnValue = 0
         DISPLAY "- SortCriteria is null ?: false"
      ELSE
         DISPLAY "- SortCriteria is null ?: true"
      END-IF
      PERFORM FmcjWLThreshold
      DISPLAY "- Threshold          : " ulongReturnValue
      PERFORM FmcjWLThresholdIsNull
```

Figure 55. Sample COBOL program to query worklists (via PERFORM) (Part 2 of 3)

Examples

```
      IF boolReturnValue = 0
         DISPLAY "- Threshold is null ?   : false"
      ELSE
         DISPLAY "- Threshold is null ?   : true"
      END-IF
      PERFORM FmcjWLDeallocate
   END-PERFORM
   PERFORM FmcjWLVectorDeallocate
END-IF
PERFORM FmcjESLogoff.
PERFORM FmcjESDeallocate.
PERFORM FmcjGlobalDisconnect.
MOVE FMC-OK TO retCode.
GOBACK.

COPY fmcperf.
```

Figure 55. Sample COBOL program to query worklists (via PERFORM) (Part 3 of 3)

```
 IDENTIFICATION DIVISION.
 PROGRAM-ID. "QUERYWL".

 DATA DIVISION.

   WORKING-STORAGE SECTION.

   COPY fmcvars.
   COPY fmcconst.
   COPY fmcrcs.

   01 localUserID   PIC X(30) VALUE z"USERID".
   01 localPassword PIC X(30) VALUE z"PASSWORD".
   01 numWList      PIC 9(9) BINARY VALUE 0.
   01 tInfo         PIC X(4097).
   01 i             PIC 9(9) BINARY VALUE 0.
   01 bufferPtr     USAGE IS POINTER VALUE NULL.

   LINKAGE SECTION.

   01 retCode            PIC S9(9) BINARY.

 PROCEDURE DIVISION USING retCode.

      CALL "FmcjGlobalConnect".
* logon
      CALL "FmcjExecutionServiceAllocate"
         USING BY REFERENCE serviceValue
         RETURNING intReturnValue.
      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "Service object could not be allocated"
         DISPLAY "rc: " retCode
         MOVE -1 TO retCode
         GOBACK
      END-IF

      CALL "SETADDR" USING localUserId userId.
      CALL "SETADDR" USING localPassword passwordValue.
      CALL "FmcjExecutionServiceLogon"
         USING BY VALUE serviceValue
                        userID
                        passwordValue
                        Fmc-SM-Default
                        Fmc-SA-Reset
         RETURNING intReturnValue.

      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "Logon failed - rc: " retCode
         CALL "FmcjExecutionServiceDeallocate"
            USING BY REFERENCE serviceValue
            RETURNING intReturnValue
         MOVE -1 TO retCode
         GOBACK
      END-IF
```

Figure 56. Sample COBOL program to query worklists (via CALL) (Part 1 of 4)

Examples

```
* query worklists
      CALL "FmcjExecutionServiceQueryWorklists"
         USING BY VALUE serviceValue
               BY REFERENCE lists
         RETURNING intReturnValue.
      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "QueryWorklists returns - rc: " retCode
      ELSE
         DISPLAY "QueryWorklists returns okay"
      END-IF

      IF retCode = FMC-OK
         SET hdlVector TO lists
         CALL "FmcjWorklistVectorSize"
            USING BY VALUE hdlVector
            RETURNING ulongReturnValue
         MOVE ulongReturnValue TO numWList
         DISPLAY "Number of worklists returned : " numWList
         PERFORM VARYING i FROM 1 BY 1 UNTIL i >= numWList
            CALL "FmcjWorklistVectorNextElement"
               USING BY VALUE hdlVector
               RETURNING FmcjWLHandleReturnValue
            SET hdlList TO FmcjWLHandleReturnValue
            MOVE 4097 TO bufferLength
            CALL "SETADDR" USING tInfo bufferPtr
            CALL "FmcjPersistentListName"
               USING BY VALUE hdlList
                              bufferPtr
                              bufferLength
               RETURNING pointerReturnValue
            DISPLAY "- Name               : " tInfo
            CALL "FmcjPersistentListType"
               USING BY VALUE hdlList
               RETURNING intReturnValue
            IF intReturnValue = Fmc-LT-Private
               DISPLAY "- Type               : private"
            END-IF
            IF intReturnValue = Fmc-LT-Public
               DISPLAY "- Type               : public"
            END-IF
            CALL "FmcjPersistentListOwnerOfList"
               USING BY VALUE hdlList
                              bufferPtr
                              bufferLength
               RETURNING pointerReturnValue
            DISPLAY "- OwnerOfList        : " tInfo
            CALL "FmcjPersistentListOwnerOfListIsNull"
               USING BY VALUE hdlList
               RETURNING boolReturnValue
            IF boolReturnValue = 0
               DISPLAY "- OwnerOfList is null ? : false"
            ELSE
               DISPLAY "- OwnerOfList is null ? : true"
            END-IF
            CALL "FmcjPersistentListDescription"
               USING BY VALUE hdlList
                              bufferPtr
                              bufferLength
               RETURNING pointerReturnValue
```

Figure 56. Sample COBOL program to query worklists (via CALL) (Part 2 of 4)

```
            DISPLAY "- Description        : " tInfo
            CALL "FmcjPersistentListDescriptionIsNull"
               USING BY VALUE hdlList
               RETURNING boolReturnValue
            IF boolReturnValue = 0
               DISPLAY "- Description is null ? : false"
            ELSE
               DISPLAY "- Description is null ? : true"
            END-IF
            CALL "FmcjPersistentListFilter"
               USING BY VALUE hdlList
                              bufferPtr
                              bufferLength
               RETURNING pointerReturnValue
            DISPLAY "- Filter             : " tInfo
            CALL "FmcjPersistentListFilterIsNull"
               USING BY VALUE hdlList
               RETURNING boolReturnValue
            IF boolReturnValue = 0
               DISPLAY "- Filter is null ?      : false"
            ELSE
               DISPLAY "- Filter is null ?      : true"
            END-IF
            CALL "FmcjPersistentListSortCriteria"
               USING BY VALUE hdlList
                              bufferPtr
                              bufferLength
               RETURNING pointerReturnValue
            DISPLAY "- SortCriteria       : " tInfo
            CALL "FmcjPersistentListSortCriteriaIsNull"
               USING BY VALUE hdlList
               RETURNING boolReturnValue
            IF boolReturnValue = 0
               DISPLAY "- SortCriteria is null ?: false"
            ELSE
               DISPLAY "- SortCriteria is null ?: true"
            END-IF
            CALL "FmcjPersistentListThreshold"
               USING BY VALUE hdlList
               RETURNING ulongReturnValue
            DISPLAY "- Threshold          : " ulongReturnValue
            CALL "FmcjPersistentListThresholdIsNull"
               USING BY VALUE hdlList
               RETURNING boolReturnValue
            IF boolReturnValue = 0
               DISPLAY "- Threshold is null ?   : false"
            ELSE
               DISPLAY "- Threshold is null ?   : true"
            END-IF
            CALL "FmcjWorklistDeallocate"
               USING BY REFERENCE hdlList
               RETURNING intReturnValue
         END-PERFORM
      CALL "FmcjWorklistVectorDeallocate"
         USING BY REFERENCE hdlVector
         RETURNING intReturnValue
      END-IF
```

Figure 56. Sample COBOL program to query worklists (via CALL) (Part 3 of 4)

Examples

```
CALL "FmcjExecutionServiceLogoff"
   USING BY VALUE serviceValue
   RETURNING intReturnValue.
CALL "FmcjExecutionServiceDeallocate"
   USING BY REFERENCE serviceValue
   RETURNING intReturnValue.
CALL "FmcjGlobalDisconnect".
MOVE FMC-OK TO retCode.
GOBACK.
```

Figure 56. Sample COBOL program to query worklists (via CALL) (Part 4 of 4)

How to query a set of objects

The following examples show how to query objects for which you are authorized. They use a query for process instances in order to demonstrate an ad-hoc query. They use work items in order to demonstrate how to query the contents of a predefined list, a worklist.

Examples

Query process instances (C)

```
#include <stdio.h>
#include <memory.h>
#include <fmcjcrun.h>                  /* MQ Workflow Runtime API */
int main()
{
  APIRET                           rc           = FMC_OK;
  FmcjExecutionServiceHandle       service      = 0;
  FmcjProcessInstanceHandle        instance     = 0;
  FmcjProcessInstanceVectorHandle iList        = 0;
  unsigned long                    numIList     = 0;
  unsigned long                    i            = 0;
  char                             tInfo[4096+1]= "";

  FmcjGlobalConnect();

  /* logon */
  rc= FmcjExecutionServiceAllocate( &service );
  if (rc != FMC_OK)
  {
    printf("Service object could not be allocated - rc: %u%\n",rc);
    return -1;
  }
  rc= FmcjExecutionServiceLogon( service,
                                 "USERID", "password",
                                 Fmc_SM_Default, Fmc_SA_NotSet
                               );
  if (rc != FMC_OK)
  {
    printf("Logon failed - rc: %u%\n",rc);
    FmcjExecutionServiceDeallocate( &service );
    return -1;
  }
  /* query process instances  */
  rc= FmcjExecutionServiceQueryProcessInstances(
                         service,
                         FmcjNoFilter, FmcjNoSortCriteria, FmcjNoThreshold,
                         &iList               );
  if ( rc != FMC_OK)
     printf( "QueryProcessInstances() returns: %u%\n",rc );
  else
     printf( "QueryProcessInstances() returns okay\n" );


  if (rc == FMC_OK)
  {
    numIList= FmcjProcessInstanceVectorSize(iList);
    printf ("Number of instances returned : %u\n", numIList);

    for( i=1; i<= numIList; i++ )
    {
      instance= FmcjProcessInstanceVectorNextElement(iList);
      FmcjProcessInstanceName( instance, tInfo, 4097 );
      printf("- Name                        : %s\n",tInfo);
      FmcjProcessInstanceDeallocate(&instance);
    }

    FmcjProcessInstanceVectorDeallocate(&iList);
  }
```

Figure 57. Sample C program to query process instances (Part 1 of 2)

```
  FmcjExecutionServiceLogoff( service );
  FmcjExecutionServiceDeallocate( &service );

  FmcjGlobalDisconnect();
  return 0;
}
```

Figure 57. Sample C program to query process instances (Part 2 of 2)

Examples

Query process instances (C++)

```
#include <iomanip.h>
#include <bool.h>                       // bool
#include <fmcjstr.hxx>                  // string
#include <vector.h>                     // vector
#include <fmcjprun.hxx>                 // MQ Workflow Runtime API
int main()
{
  FmcjGlobal::Connect();

  // logon
  FmcjExecutionService service;
  APIRET rc = service.Logon("USERID", "password");
  if ( rc != FMC_OK )
  {
    cout << "Logon failed, - rc: " << rc << endl;
    return -1;
  }


  // query process instances

  vector<FmcjProcessInstance> instances;

  rc = service.QueryProcessInstances(
                   FmcjNoFilter, FmcjNoSortCriteria, FmcjNoThreshold,
                   instances );
  if ( rc != FMC_OK)
     cout << "QueryProcessInstances returns: " << rc << endl;
  else
     cout << "QueryProcessInstances okay" << endl;
  if ( rc == FMC_OK )
  {
    cout << "Number of instances returned: " << instances.size() << endl;

    for ( int i=0; i < instances.size(); i++ )
      cout << "- Name: " << instances[i].Name() << endl;
  }

  service.Logoff();

  FmcjGlobal::Disconnect();
  return 0;
}
```

Figure 58. Sample C++ program to query process instances

Query process instances (Java)

```
import com.ibm.workflow.api.*;
import com.ibm.workflow.api.ServicePackage.*;

public class QueryProcInst
{
  public static void main(String[] args)
  {
    // Check the arguments. The first argument is the name of the MQSeries
    // Workflow agent the client will connect to. The second argument defines
    // the locator policy the client will use when trying to contact the agent.
    // The third/fourth argument define the userid/password, which, if not
    // specified, default to USERID and password

    if ((args.length < 2 ) || (args.length > 4 ))
    {
      System.out.println("Usage:");
      System.out.println(" java QueryProcessInstances [userid] [password]");
      System.exit(0);
    }


try
    {
      // An agent bean representing an MQSeries Workflow domain
      String userid = "USERID";
      String passwd = "password";
      Agent agent = new Agent();
      // Parse the command line and set the locator to be used to
      // communicate with the agent.
      if      (args[1].equalsIgnoreCase("LOC"))
      {
        agent.setLocator(Agent.LOC_LOCATOR);
      }
      else if (args[1].equalsIgnoreCase("RMI"))
      {
        agent.setLocator(Agent.RMI_LOCATOR);
      }
      else if (args[1].equalsIgnoreCase("OSA"))
      {
        agent.setLocator(Agent.OSA_LOCATOR);
      }
      else if (args[1].equalsIgnoreCase("IOR"))
      {
        agent.setLocator(Agent.IOR_LOCATOR);
      }
      else if (args[1].equalsIgnoreCase("COS"))
      {
        agent.setLocator(Agent.COS_LOCATOR);
      }
      else
      {
        System.out.println("Invalid locator policy: " + args[1]);
        System.exit(0);
      }
```

Figure 59. Sample Java program to query process instances (Part 1 of 3)

Examples

```
if (args.length >=3 ) userid = args[2].toUpperCase();
if (args.length >=4 ) passwd = args[3];

// Set the name of the Agent to be contacted. Setting the name
// automatically instructs the agent bean to contact the Agent using
// the current locator policy. For this reason the 'setLocator' must be
// called before 'setName' is invoked. If the agent bean cannot contact
// the Agent, it will raise a java.beans.PropertyVetoException instead
// of returning from the 'setName' call.
agent.setName(args[0]);

// Locate the default execution service in the system group named
// 'SYS_GRP' and the system named 'FMCSYS'. This call intentionally
// always returns successful (to prevent intrusion attempts which guess
// at service names until they find a valid one). Of course, only using
// a valid systemgroup and/or system name will return an ExecutionService
// which can be used to log on.
ExecutionService service = agent.locate("", "");


// Log on to the execution service. If the UserID and/or the password is
// invalid, an FmcException will be thrown.
// do a forced logon
service.logon2(userid, passwd, SessionMode.PRESENT_HERE,
               AbsenceIndicator.LEAVE );
System.out.println("Logon successful");


// Query a set of processinstances (30 at maximum), sort them by name
ProcessInstance[] procInstances =
  service.queryProcessInstances("","NAME DESC", 30);

if (procInstances.length == 0)
{
  System.out.println("  No process instances found");
}
else
{
  System.out.println("Number of instances returned: " + procInstances.length);



  // Iterate over the process instances, printing out their names.
  for (int ndx = 0; ndx < procInstances.length; ndx++)
  {
    System.out.println("   - Name: " + procInstances[ndx].name());
  }
}


// Logoff from the execution service. This (like any other remote call)
   // may raise an FmcException indicating a communication failure.
   service.logoff();

   System.out.println("Logoff successful");
 }
```

Figure 59. Sample Java program to query process instances (Part 2 of 3)

```
catch(FmcException e)
    {
      // Catch and report details about the FmcException
      System.out.println("FmcException occured");
      System.out.println("  RC         : " + e.rc);
      System.out.println("  Origin     : " + e.origin);
      System.out.println("  MessageText: " + e.messageText);
      System.out.println("  Exception  : " + e.getMessage());
      System.out.println("  Parameters : ");
      for ( int i = 0; i < e.parameters.length ; i++)
      {
        System.out.println("    " + e.parameters[i] );
      }
      System.out.println("  StackTrace : ");
      e.printStackTrace();
    }

    catch(Exception e)
    {
      // Catch and report any exception that occurred.
      e.printStackTrace();
    }

    System.exit(0);
  }
}
```

Figure 59. Sample Java program to query process instances (Part 3 of 3)

Examples

Query process instances (COBOL)

```
IDENTIFICATION DIVISION.
PROGRAM-ID. "QUERYPI".

DATA DIVISION.

  WORKING-STORAGE SECTION.

  COPY fmcvars.
  COPY fmcconst.
  COPY fmcrcs.

  01 localUserID   PIC X(30) VALUE z"USERID".
  01 localPassword PIC X(30) VALUE z"PASSWORD".
  01 numIList      PIC 9(9) BINARY VALUE 0.
  01 tInfo         PIC X(4097).
  01 i             PIC 9(9) BINARY VALUE 0.

  LINKAGE SECTION.

  01 retCode            PIC S9(9) BINARY.

PROCEDURE DIVISION USING retCode.

     PERFORM FmcjGlobalConnect.

* logon
      PERFORM FmcjESAllocate.
      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "Service object could not be allocated"
         DISPLAY "rc: " retCode
         MOVE -1 TO retCode
         GOBACK
      END-IF

      CALL "SETADDR" USING localUserId userId.
      CALL "SETADDR" USING localPassword passwordValue.
      MOVE Fmc-SM-Default TO sessionMode.
      MOVE Fmc-SA-Reset TO absenceIndicator.
      PERFORM FmcjESLogon.

      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "Logon failed - rc: " retCode
         PERFORM FmcjESDeallocate
         MOVE -1 TO retCode
         GOBACK
      END-IF
```

Figure 60. Sample COBOL program to query process instances (via PERFORM) (Part 1 of 2)

```
* query process instances
      CALL "SETADDR" USING FmcjNoFilter filter.
      CALL "SETADDR" USING FmcjNoSortCriteria sortCriteria.
      MOVE FmcjNoThreshold TO threshold.
      PERFORM FmcjESQueryProcInsts.

      SET hdlVector TO instances.
      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "QueryProcessInstances returns: " retCode
      ELSE
         DISPLAY "QueryProcessInstances returns okay"
      END-IF

      IF retCode = FMC-OK
         PERFORM FmcjPIVSize
         MOVE ulongReturnValue TO numIList
         DISPLAY "Number of instances returned: " numIList
         MOVE 4097 TO bufferLength
         CALL "SETADDR" USING tInfo instanceNameBuffer
         PERFORM VARYING i FROM 1 BY 1 UNTIL i > numIList
            PERFORM FmcjPIVNextElement
            SET hdlInstance TO FmcjPIHandleReturnValue
            PERFORM FmcjPIName
            DISPLAY "- name: " tInfo
            PERFORM FmcjPIDeallocate
         END-PERFORM
         PERFORM FmcjPIVDeallocate
      END-IF

      PERFORM FmcjESLogoff.
      PERFORM FmcjESDeallocate.
      PERFORM FmcjGlobalDisconnect.
      MOVE FMC-OK TO retCode.
      GOBACK.

      COPY fmcperf.
```

Figure 60. Sample COBOL program to query process instances (via PERFORM) (Part 2 of 2)

Examples

```
 IDENTIFICATION DIVISION.
 PROGRAM-ID. "QUERYPI".

 DATA DIVISION.

   WORKING-STORAGE SECTION.

   COPY fmcvars.
   COPY fmcconst.
   COPY fmcrcs.

   01 localUserID   PIC X(30) VALUE z"USERID".
   01 localPassword PIC X(30) VALUE z"PASSWORD".
   01 numIList      PIC 9(9) BINARY VALUE 0.
   01 tInfo         PIC X(4097).
   01 i             PIC 9(9) BINARY VALUE 0.

   LINKAGE SECTION.

   01 retCode            PIC S9(9) BINARY.

 PROCEDURE DIVISION USING retCode.

     CALL "FmcjGlobalConnect".
* logon
      CALL "FmcjExecutionServiceAllocate"
         USING BY REFERENCE serviceValue
         RETURNING intReturnValue.
      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "Service object could not be allocated"
         DISPLAY "rc: " retCode
         MOVE -1 TO retCode
         GOBACK
      END-IF

      CALL "SETADDR" USING localUserId userId.
      CALL "SETADDR" USING localPassword passwordValue.
      CALL "FmcjExecutionServiceLogon"
         USING BY VALUE serviceValue
                        userID
                        passwordValue
                        Fmc-SM-Default
                        Fmc-SA-Reset
         RETURNING intReturnValue.

      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "Logon failed - rc: " retCode
         CALL "FmcjExecutionServiceDeallocate"
            USING BY REFERENCE serviceValue
            RETURNING intReturnValue
         MOVE -1 TO retCode
         GOBACK
      END-IF
```

Figure 61. Sample COBOL program to query process instances (via CALL) (Part 1 of 2)

```
* query process instances
      CALL "SETADDR" USING FmcjNoFilter filter.
      CALL "SETADDR" USING FmcjNoSortCriteria sortCriteria.
      CALL "FmcjExecutionServiceQueryProcessInstances"
         USING BY VALUE     serviceValue
                            filter
                            sortCriteria
                            FmcjNoThreshold
               BY REFERENCE instances
               RETURNING intReturnValue.

      SET hdlVector TO instances.
      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "QueryProcessInstances returns: " retCode
      ELSE
         DISPLAY "QueryProcessInstances returns okay"
      END-IF

      IF retCode = FMC-OK
         CALL "FmcjProcessInstanceVectorSize"
            USING BY VALUE hdlVector
            RETURNING ulongReturnValue
         MOVE ulongReturnValue TO numIList
         DISPLAY "Number of instances returned: " numIList
         MOVE 4097 TO bufferLength
         CALL "SETADDR" USING tInfo instanceNameBuffer
         PERFORM VARYING i FROM 1 BY 1 UNTIL i > numIList
            CALL "FmcjProcessInstanceVectorNextElement"
               USING BY VALUE hdlVector
               RETURNING FmcjPIHandleReturnValue
            SET hdlInstance TO FmcjPIHandleReturnValue
            CALL "FmcjProcessInstanceName"
               USING BY VALUE hdlInstance
                              instanceNameBuffer
                              FMC-PROC-INST-NAME-LENGTH
               RETURNING pointerReturnValue
            DISPLAY "- name: " tInfo
            CALL "FmcjProcessInstanceDeallocate"
               USING BY REFERENCE hdlInstance
               RETURNING intReturnValue
         END-PERFORM
         CALL "FmcjProcessInstanceVectorDeallocate"
            USING BY REFERENCE hdlVector
            RETURNING intReturnValue
      END-IF

      CALL "FmcjExecutionServiceLogoff"
         USING BY VALUE serviceValue
         RETURNING intReturnValue.
      CALL "FmcjExecutionServiceDeallocate"
         USING BY REFERENCE serviceValue
         RETURNING intReturnValue.
      CALL "FmcjGlobalDisconnect".
      MOVE FMC-OK TO retCode.
      GOBACK.
```

Figure 61. Sample COBOL program to query process instances (via CALL) (Part 2 of 2)

Examples

Query work items from a worklist (C)

```
#include <stdio.h>
#include <string.h>
#include <fmcjcrun.h>                  /* MQ Workflow Runtime API */

int main (int argc, char ** argv)
{
  APIRET                       rc            = FMC_OK;
  FmcjExecutionServiceHandle   service       = 0;
  FmcjWorklistVectorHandle     wLists        = 0;
  FmcjWorklistHandle           worklist      = 0;
  FmcjWorkitemVectorHandle     wVector       = 0;
  FmcjWorkitemHandle           workitem      = 0;
  unsigned long                numWList      = 0;
  char                         tInfo[4096+1] = "";

  FmcjGlobalConnect();

  /*  Logon */
  rc= FmcjExecutionServiceAllocate( &service );
  if (rc != FMC_OK)
  {
    printf("Service object could not be allocated: %u%\n",rc);
    return -1;
  }

  rc= FmcjExecutionServiceLogon( service,
                                 "USERID", "password",
                                 Fmc_SM_Default, Fmc_SA_NotSet );
  if ( rc != FMC_OK )
  {
    printf("Logon failed - rc    : %u%\n",rc);
    rc= FmcjExecutionServiceDeallocate( &service );
    return -1;
  }

  /* query worklists  */
  rc = FmcjExecutionServiceQueryWorklists( service, &wLists );
  if ( rc != FMC_OK)
     printf( "QueryWorklists() returns: %u%\n",rc );
  else
     printf( "QueryWorklists() returns okay\n" );


  if (rc == FMC_OK)
  {
    numWList= FmcjWorklistVectorSize(wLists);
    printf ("Number of worklists returned : %u\n", numWList);
    if ( numWList == 0 )
    {
      printf("No worklist found \n");
      FmcjWorklistVectorDeallocate(&wLists);
      rc= FmcjExecutionServiceDeallocate( &service );
      return -1;
    }

    worklist= FmcjWorklistVectorFirstElement(wLists);
    FmcjWorklistName( worklist, tInfo, 4097 );
    printf("Name                          : %s\n",tInfo);
```

Figure 62. Sample C program to query work items from a worklist (Part 1 of 2)

```
    /* query workitems  */
    rc= FmcjWorklistQueryWorkitems( worklist, &wVector );
    printf("\nQuery workitems of list returns rc: %u\n",rc);

    if (rc == FMC_OK)
    {
      while ( 0 != (workitem= FmcjWorkitemVectorNextElement(wVector)) )
      {
        FmcjWorkitemName( workitem, tInfo, 4097 );
        printf("- Name                        : %s\n",tInfo);

        FmcjWorkitemDeallocate(&workitem);
      }
    }

    FmcjWorklistDeallocate(&worklist);
    FmcjWorklistVectorDeallocate(&wLists);
  }

  /*  Logoff */
  rc= FmcjExecutionServiceLogoff(service);
  rc= FmcjExecutionServiceDeallocate( &service );

  FmcjGlobalDisconnect();
  return 0;
}
```

Figure 62. Sample C program to query work items from a worklist (Part 2 of 2)

Examples

Query work items from a worklist (C++)

```
#include <iomanip.h>
#include <bool.h>                       // bool
#include <fmcjstr.hxx>                  // string
#include <vector.h>                     // vector
#include <fmcjprun.hxx>                 // MQ Workflow Runtime API
int main()
{
  FmcjGlobal::Connect();


  // logon
  FmcjExecutionService service;
  APIRET rc = service.Logon("USERID", "password");
  if ( rc != FMC_OK )
  {
    cout << "Logon failed, - rc: " << rc << endl;
    return -1;
  }


  // query worklists

  vector<FmcjWorklist> lists;
  FmcjWorklist         worklist;

  rc = service.QueryWorklists( lists );
  if ( rc != FMC_OK)
     cout << "QueryWorklists() returns: " << rc << endl;
  else
     cout << "QueryWorklists returns okay" << endl;

  if (rc == FMC_OK)
  {
    unsigned int numWList= lists.size();
    cout << "Number of worklists returned : " << numWList << endl;
    if ( numWList == 0 )
    {
      cout << "No worklist found" << endl;
      return -1;
    }


    worklist= lists[0];
    cout << "Name              : " << worklist.Name()              << endl;

    vector<FmcjWorkitem> wVector;
    FmcjWorkitem         workitem;

    rc= worklist.QueryWorkitems( wVector );
    cout << "Query workitems of list returns: " << rc << endl;
    cout << "Number of workitems              " << wVector.size() << endl;
```

Figure 63. Sample C++ program to query work items from a worklist (Part 1 of 2)

```
    if (rc == FMC_OK)
    {
      for ( int i= 0; i < wVector.size(); i++ )
      {
        workitem= wVector[i];
        cout << "Name              : " << workitem.Name() << endl;
      }
    }
  }

  rc = service.Logoff();

  FmcjGlobal::Disconnect();
  return 0;
}
```

Figure 63. Sample C++ program to query work items from a worklist (Part 2 of 2)

Examples

Query work items from a worklist (Java)

```
import com.ibm.workflow.api.*;
import com.ibm.workflow.api.ServicePackage.*;

public class QueryWorkItems
{
  public static void main(String[] args)
  {
    // Check the arguments. The first argument is the name of the MQSeries
    // Workflow agent the client will connect to. The second argument defines
    // the locator policy the client will use when trying to contact the agent.
    // The third/fourth argument define the userid/password, which, if not
    // specified, default to USERID and password

    if ((args.length < 2 ) || (args.length > 4 ))
    {
      System.out.println("Usage:");
      System.out.println(" java QueryWorkitems [userid] [password]");
      System.exit(0);
    }


    try
    {
      // An agent bean representing an MQSeries Workflow domain
      String userid = "USERID";
      String passwd = "password";
      Agent agent = new Agent();

      // Parse the command line and set the locator to be used to
      // communicate with the agent.
      if      (args[1].equalsIgnoreCase("LOC"))
      {
        agent.setLocator(Agent.LOC_LOCATOR);
      }
      else if (args[1].equalsIgnoreCase("RMI"))
      {
        agent.setLocator(Agent.RMI_LOCATOR);
      }
      else if (args[1].equalsIgnoreCase("OSA"))
      {
        agent.setLocator(Agent.OSA_LOCATOR);
      }
      else if (args[1].equalsIgnoreCase("IOR"))
      {
        agent.setLocator(Agent.IOR_LOCATOR);
      }
      else if (args[1].equalsIgnoreCase("COS"))
      {
        agent.setLocator(Agent.COS_LOCATOR);
      }
      else
      {
        System.out.println("Invalid locator policy: " + args[1]);
        System.exit(0);
      }


      if (args.length >=3 ) userid = args[2].toUpperCase();
      if (args.length >=4 ) passwd = args[3];
```

Figure 64. Sample Java program to query work items from a worklist (Part 1 of 3)

```
    // Set the name of the Agent to be contacted. Setting the name
    // automatically instructs the agent bean to contact the Agent using
    // the current locator policy. For this reason the 'setLocator' must be
    // called before 'setName' is invoked. If the agent bean cannot contact
    // the Agent, it will raise a java.beans.PropertyVetoException instead
    // of returning from the 'setName' call.
    agent.setName(args[0]);

    // Locate the default execution service in the system group named
    // 'SYS_GRP' and the system named 'FMCSYS'. This call intentionally
    // always returns successful (to prevent intrusion attempts which guess
    // at service names until they find a valid one). Of course, only using
    // a valid systemgroup and/or system name will return an ExecutionService
    // which can be used to log on.
    ExecutionService service = agent.locate("", "");

    // Log on to the execution service. If the UserID and/or the password is
    // invalid, a FmcException will be thrown.
    // do a forced logon
    service.logon2(userid, passwd, SessionMode.PRESENT_HERE,
                   AbsenceIndicator.LEAVE );
    System.out.println("Logon successful");


    // Query the set of worklists the logged on user can access.
    WorkList[] worklists = service.queryWorkLists();

    if (worklists.length == 0)
    {
      System.out.println("  No worklist found");
    }
    else
    {
      System.out.println("  Number of worklists returned: " + worklists.length);

      WorkList worklist = worklists[0];
      System.out.println("  Name: "+worklist.name());


      // Query the set of workitems in the first worklist.
      WorkItem[] workitems = worklist.queryWorkItems();
      System.out.println("  Number of workitems: " + workitems.length);

      // Iterate over the workitems, printing out their names.
      for (int ndx = 0; ndx < workitems.length; ndx++)
      {
        System.out.println("    " + workitems[ndx].name());
      }
    }/* End if*/


    // Logoff from the execution service. This (like any other remote call)
    // may raise an FmcException indicating a communication failure.
    service.logoff();

    System.out.println("Logoff successful");
  }
```

Figure 64. Sample Java program to query work items from a worklist (Part 2 of 3)

Examples

```
 catch(FmcException e)
    {
      // Catch and report details about the FmcException
      System.out.println("FmcException occured");
      System.out.println("  RC         : " + e.rc);
      System.out.println("  Origin     : " + e.origin);
      System.out.println("  MessageText: " + e.messageText);
      System.out.println("  Exception  : " + e.getMessage());
      System.out.println("  Parameters : ");
      for ( int i = 0; i < e.parameters.length ; i++)
      {
        System.out.println("    " + e.parameters[i] );
      }
      System.out.println("  StackTrace : ");
      e.printStackTrace();
    }


   catch(Exception e)
    {
      // Catch and report any exception that occurred.
      e.printStackTrace();
    }

    System.exit(0);
  }
}
```

Figure 64. Sample Java program to query work items from a worklist (Part 3 of 3)

Query work items from a worklist (COBOL)

```
 IDENTIFICATION DIVISION.
 PROGRAM-ID. "QUERYWI".

 DATA DIVISION.

   WORKING-STORAGE SECTION.

   COPY fmcvars.
   COPY fmcconst.
   COPY fmcrcs.

   01 localUserID   PIC X(30) VALUE z"USERID".
   01 localPassword PIC X(30) VALUE z"PASSWORD".
   01 numWList      PIC 9(9) BINARY VALUE 0.
   01 tInfo         PIC X(4097).

   LINKAGE SECTION.

   01 retCode            PIC S9(9) BINARY.

 PROCEDURE DIVISION USING retCode.

      PERFORM FmcjGlobalConnect.

* logon
      PERFORM FmcjESAllocate.
      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "Service object could not be allocated"
         DISPLAY "rc: " retCode
         MOVE -1 TO retCode
         GOBACK
      END-IF

      CALL "SETADDR" USING localUserId userId.
      CALL "SETADDR" USING localPassword passwordValue.
      MOVE Fmc-SM-Default TO sessionMode.
      MOVE Fmc-SA-Reset TO absenceIndicator.
      PERFORM FmcjESLogon.

      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "Logon failed - rc: " retCode
         PERFORM FmcjESDeallocate
         MOVE -1 TO retCode
         GOBACK
      END-IF

* query worklists
      PERFORM FmcjESQueryWorklists.
      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "QueryWorklists returns - rc: " retCode
      ELSE
         DISPLAY "QueryWorklists returns okay"
      END-IF
```

Figure 65. Sample COBOL program to query work items from a worklist (via PERFORM) (Part 1 of 2)

Examples

```
      IF retCode = FMC-OK
         SET hdlVector TO lists
         PERFORM FmcjWLVectorSize
         MOVE ulongReturnValue TO numWList
         DISPLAY "Number of worklists returned : " numWList
         IF numWList = 0
            DISPLAY "No worklist found"
            PERFORM FmcjWLDeallocate
            PERFORM FmcjESDeallocate
            MOVE -1 TO retCode
            GOBACK
         END-IF

         PERFORM FmcjWLVectorFirstElement
         SET hdlList TO FmcjWLHandleReturnValue
         MOVE 4097 TO bufferLength
         CALL "SETADDR" USING tInfo listNameBuffer
         PERFORM FmcjWLName
         DISPLAY "Name               : " tInfo

* query workitems
         PERFORM FmcjWLQueryWorkitems
         MOVE intReturnValue TO retCode
         DISPLAY "Query workitems of list returns rc:" retCode
         SET hdlVector TO workitems
         CALL "SETADDR" USING tInfo itemNameBuffer
         IF retCode = FMC-OK
            PERFORM FmcjWIVNextElement
            SET hdlItem TO FmcjWIHandleReturnValue
            PERFORM UNTIL pointerReturnValue = NULL
               PERFORM FmcjWIName
               DISPLAY "- Name             : " tInfo
               PERFORM FmcjWIDeallocate
               PERFORM FmcjWIVNextElement
            END-PERFORM
         END-IF
         PERFORM FmcjWLDeallocate
         PERFORM FmcjWLVectorDeallocate
      END-IF

      PERFORM FmcjESLogoff.
      PERFORM FmcjESDeallocate.
      PERFORM FmcjGlobalDisconnect.
      MOVE FMC-OK TO retCode.
      GOBACK.

      COPY fmcperf.
```

Figure 65. Sample COBOL program to query work items from a worklist (via PERFORM) (Part 2 of 2)

```
 IDENTIFICATION DIVISION.
 PROGRAM-ID. "QUERYWI".

 DATA DIVISION.

   WORKING-STORAGE SECTION.

   COPY fmcvars.
   COPY fmcconst.
   COPY fmcrcs.

   01 localUserID   PIC X(30) VALUE z"USERID".
   01 localPassword PIC X(30) VALUE z"PASSWORD".
   01 numWList      PIC 9(9) BINARY VALUE 0.
   01 tInfo         PIC X(4097).

   LINKAGE SECTION.

   01 retCode            PIC S9(9) BINARY.

 PROCEDURE DIVISION USING retCode.

      CALL "FmcjGlobalConnect".
* logon
      CALL "FmcjExecutionServiceAllocate"
         USING BY REFERENCE serviceValue
         RETURNING intReturnValue.
      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "Service object could not be allocated"
         DISPLAY "rc: " retCode
         MOVE -1 TO retCode
         GOBACK
      END-IF

      CALL "SETADDR" USING localUserId userId.
      CALL "SETADDR" USING localPassword passwordValue.
      CALL "FmcjExecutionServiceLogon"
         USING BY VALUE serviceValue
                        userID
                        passwordValue
                        Fmc-SM-Default
                        Fmc-SA-Reset
         RETURNING intReturnValue.

      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "Logon failed - rc: " retCode
         CALL "FmcjExecutionServiceDeallocate"
            USING BY REFERENCE serviceValue
            RETURNING intReturnValue
         MOVE -1 TO retCode
         GOBACK
      END-IF
```

Figure 66. Sample COBOL program to query work items from a worklist (via CALL) (Part 1 of 3)

Examples

```
* query worklists
      CALL "FmcjExecutionServiceQueryWorklists"
         USING BY VALUE serviceValue
               BY REFERENCE lists
         RETURNING intReturnValue.
      MOVE intReturnValue TO retCode
      IF retCode NOT = FMC-OK
         DISPLAY "QueryWorklists returns - rc: " retCode
      ELSE
         DISPLAY "QueryWorklists returns okay"
      END-IF

      IF retCode = FMC-OK
         SET hdlVector TO lists
         CALL "FmcjWorklistVectorSize"
            USING BY VALUE hdlVector
            RETURNING ulongReturnValue
         MOVE ulongReturnValue TO numWList
         DISPLAY "Number of worklists returned : " numWList
         IF numWList = 0
            DISPLAY "No worklist found"
            CALL "FmcjWorklistDeallocate"
               USING BY REFERENCE hdlList
               RETURNING intReturnValue
            CALL "FmcjExecutionServiceDeallocate"
               USING BY REFERENCE serviceValue
               RETURNING intReturnValue
            MOVE -1 TO retCode
            GOBACK
         END-IF

         CALL "FmcjWorklistVectorFirstElement"
            USING BY VALUE hdlVector
            RETURNING FmcjWLHandleReturnValue
         SET hdlList TO FmcjWLHandleReturnValue
         MOVE 4097 TO bufferLength
         CALL "SETADDR" USING tInfo listNameBuffer
         CALL "FmcjPersistentListName"
            USING BY VALUE hdlList
                           listNameBuffer
                           bufferLength
            RETURNING pointerReturnValue
         DISPLAY "Name               : " tInfo

* query workitems
         CALL "FmcjWorklistQueryWorkitems"
            USING BY VALUE hdlList
            BY REFERENCE workitems
            RETURNING intReturnValue
         MOVE intReturnValue TO retCode
         DISPLAY "Query workitems of list returns rc:" retCode
         SET hdlVector TO workitems
         CALL "SETADDR" USING tInfo itemNameBuffer
         IF retCode = FMC-OK
            CALL "FmcjWorkitemVectorNextElement"
               USING BY VALUE hdlVector
               RETURNING FmcjWIHandleReturnValue
            SET hdlItem TO FmcjWIHandleReturnValue
```

Figure 66. Sample COBOL program to query work items from a worklist (via CALL) (Part 2 of 3)

```
      PERFORM UNTIL pointerReturnValue = NULL
         CALL "FmcjItemName"
            USING BY VALUE hdlItem
                           itemNameBuffer
                           bufferLength
            RETURNING pointerReturnValue
         DISPLAY "- Name             : " tInfo
         CALL "FmcjWorkitemDeallocate"
            USING BY REFERENCE hdlWorkitem
            RETURNING intReturnValue
         CALL "FmcjWorkitemVectorNextElement"
            USING BY VALUE hdlVector
            RETURNING FmcjWIHandleReturnValue
      END-PERFORM
   END-IF
   CALL "FmcjWorklistDeallocate"
      USING BY REFERENCE hdlList
      RETURNING intReturnValue
   CALL "FmcjWorklistVectorDeallocate"
      USING BY REFERENCE hdlVector
      RETURNING intReturnValue
END-IF

    CALL "FmcjExecutionServiceLogoff"
   USING BY VALUE serviceValue
   RETURNING intReturnValue.
CALL "FmcjExecutionServiceDeallocate"
   USING BY REFERENCE serviceValue
   RETURNING intReturnValue.
CALL "FmcjGlobalDisconnect".
MOVE FMC-OK TO retCode.
GOBACK.
```

Figure 66. Sample COBOL program to query work items from a worklist (via CALL) (Part 3 of 3)

How to code an activity implementation

The following examples show the concept of how to query and set containers from within an activity implementation. Refer to the examples provided with the product for more details.

Programming an activity implementation (C)

```
#include <stdio.h>
#include <fmcjccon.h>                  /* MQ Workflow Container API */
int main()
{
  FILE                           *  file1             = 0;
  APIRET                            rc                = FMC_OK;
  FmcjReadOnlyContainerHandle       input             = 0;
  FmcjReadWriteContainerHandle      output            = 0;
  char                              stringBuffer[4097]="";

/*- keep results in a file ---------------------------------------------*/
  file1 = fopen ("sample.out", "a");
  if ( file1 == 0 )
    return -1;
  fprintf(file1,"\n----- C-API Activity Implementation called -----\n");
  fflush(file1);

  FmcjGlobalConnect();

/*-- retrieve the input container from the PEA who started the program --*/
  rc = FmcjContainerInContainer( &input );
  fprintf(file1, "Get Input Container - rc:  %u\n", rc);
  if (rc != FMC_OK)
  {
    fclose(file1);
    return 1;
  }

  fprintf(file1, "Input Container Name: %s\n",
          FmcjReadOnlyContainerType(input, stringBuffer, 4097));

/*-- retrieve the output container from the PEA who started the program -*/
  rc = FmcjContainerOutContainer( &output );
  fprintf(file1, "Get Output Container - rc:  %u\n", rc);
  if (rc != FMC_OK)
  {
    fclose(file1);
    return 1;
  }

  fprintf(file1, "Output Container Name: %s\n",
          FmcjReadWriteContainerType(output, stringBuffer, 4097));

/*----- Modify output values ------------------------------------------*/
  rc= FmcjReadWriteContainerSetLongValue(output, "aFieldInTheOutput",42);
  fprintf(file1, "\nSetting long value returns rc: %u\n", rc);

  ...

/*-- return the output container to the PEA who started the program -----*/
  rc = FmcjContainerSetOutContainer( output );
  fprintf(file1, "\nSet Output Container - rc: %u\n",rc);
  fflush(file1);

  FmcjGlobalDisconnect();
  fclose(file1);
  return 0;                          // _RC passed to MQSeries Workflow
}
```

Figure 67. Sample activity implementation (C)

Examples

Programming an activity implementation (C++)

```
#include <fstream.h>
#include <bool.h>                       // bool
#include <fmcjstr.hxx>                  // string
#include <vector.h>                     // vector
#include <fmcjpcon.hxx>                 // MQ Workflow Container API
int main()
{
/*- keep results in a file ------------------------------------------------*/
  ofstream file1("sample.out");
  if ( file1 == 0 )
    return -1;

  file1 << "\n----- C++-API Activity Implementation called -----\n" << endl;
  FmcjGlobal::Connect();

/*-- retrieve the input container from the PEA who started the program --*/
  FmcjReadOnlyContainer input;

  APIRET rc = FmcjContainer::InContainer( input );
  file1 << "Get Input Container - rc: " << rc << endl;
  if (rc != FMC_OK)
  {
    file1.close();
    return 1;
  }

  file1 << "Input Container Name: " << input.Type() << endl;
/*-- retrieve the output container from the PEA who started the program -*/
  FmcjReadWriteContainer  output;

  rc = FmcjContainer::OutContainer( output );
  file1 << "Get Output Container - rc: " << rc << endl;
  if (rc != FMC_OK)
  {
    file1.close();
    return 1;
  }

  file1 << "Output Container Name: " << output.Type() << endl;
/*----- Modify output values ---------------------------------------------*/
  rc= output.SetValue("aFieldInTheOutput",42L);
  file1 << "Setting long value returns rc: " << rc << endl;

  ...
/*-- return the output container to the PEA who started the program -----*/
  rc = FmcjContainer::SetOutContainer( output );
  file1 << "Set Output Container - rc: " << rc << endl;

  FmcjGlobal::Disconnect();
  file1.close();
  return 0;                             // _RC passed to MQSeries Workflow
}
```

Figure 68. Sample activity implementation (C++)

Programming an activity implementation (COBOL)

```
 IDENTIFICATION DIVISION.
 PROGRAM-ID. "EXEC".

 DATA DIVISION.


   WORKING-STORAGE SECTION.

   COPY fmcvars.
   COPY fmcrcs.

   01 stringBuffer  PIC X(4097).
   01 fieldName     PIC X(39) VALUE z"aFieldInTheOutput".

   LINKAGE SECTION.

   01 retCode            PIC S9(9) BINARY.

 PROCEDURE DIVISION USING retCode.

      DISPLAY "-- COBOL-API Activity Implementation called --"
      PERFORM FmcjGlobalConnect.

* retrieve the input container
      PERFORM FmcjCInCtnr.
      MOVE intReturnValue TO retCode.
      DISPLAY "Get Input Container - rc: " retCode.
      IF retCode NOT = FMC-OK
         MOVE 1 TO retCode
         GOBACK
      END-IF

      CALL "SETADDR" USING stringBuffer containerTypeBuffer.
      MOVE 4097 TO bufferLength.
      SET hdlContainer TO inputValue.
      PERFORM FmcjROCType.
      DISPLAY "Input Container Name: " stringBuffer.

* retrieve the output container
      PERFORM FmcjCOutCtnr.
      MOVE intReturnValue TO retCode.
      DISPLAY "Get Output Container - rc: " retCode.
      IF retCode NOT = FMC-OK
         MOVE 1 TO retCode
         GOBACK
      END-IF

      SET hdlContainer TO outputValue.
      PERFORM FmcjRWCType.
      DISPLAY "Output Container Name: " stringBuffer.
```

Figure 69. Sample activity implementation (COBOL, via PERFORM) (Part 1 of 2)

Examples

```
* modify output values
      MOVE 42 TO intValue.
      CALL "SETADDR" USING fieldName qualifiedName.
      PERFORM FmcjRWCSetLongValue.
      MOVE intReturnValue TO retCode.
      DISPLAY "Setting long value returns rc: " retCode.

* return the output container
      PERFORM FmcjCSetOutCtnr.
      MOVE intReturnValue TO retCode.
      DISPLAY "Set Output Container - rc: " retCode.

      PERFORM FmcjGlobalDisconnect.
      MOVE FMC-OK TO retCode.
      GOBACK.

      COPY fmcperf.
```

Figure 69. Sample activity implementation (COBOL, via PERFORM) (Part 2 of 2)

```
 IDENTIFICATION DIVISION.
 PROGRAM-ID. "EXEC".

 DATA DIVISION.

   WORKING-STORAGE SECTION.

   COPY fmcvars.
   COPY fmcrcs.

   01 stringBuffer  PIC X(4097).
   01 fieldName     PIC X(39) VALUE z"aFieldInTheOutput".

   LINKAGE SECTION.

   01 retCode            PIC S9(9) BINARY.

 PROCEDURE DIVISION USING retCode.

      DISPLAY "-- COBOL-API Activity Implementation called --"
      CALL "FmcjGlobalConnect".

* retrieve the input container
      CALL "FmcjContainerInContainer"
         USING BY REFERENCE inputValue
         RETURNING intReturnValue.
      MOVE intReturnValue TO retCode.
      DISPLAY "Get Input Container - rc: " retCode.
      IF retCode NOT = FMC-OK
         MOVE 1 TO retCode
         GOBACK
      END-IF

      CALL "SETADDR" USING stringBuffer containerTypeBuffer.
      MOVE 4097 TO bufferLength.
      SET hdlContainer TO inputValue.
      CALL "FmcjContainerType"
         USING BY VALUE hdlContainer
                        containerTypeBuffer
                        bufferLength
         RETURNING pointerReturnValue.
      DISPLAY "Input Container Name: " stringBuffer.

* retrieve the output container
      CALL "FmcjContainerOutContainer"
         USING BY REFERENCE outputValue
         RETURNING intReturnValue.
      MOVE intReturnValue TO retCode.
      DISPLAY "Get Output Container - rc: " retCode.
      IF retCode NOT = FMC-OK
         MOVE 1 TO retCode
         GOBACK
      END-IF

      SET hdlContainer TO outputValue.
      CALL "FmcjContainerType"
         USING BY VALUE hdlContainer
                        containerTypeBuffer
                        bufferLength
         RETURNING pointerReturnValue.
      DISPLAY "Output Container Name: " stringBuffer.

* modify output values
      MOVE 42 TO intValue.
      CALL "SETADDR" USING fieldName qualifiedName.
```

Figure 70. Sample activity implementation (COBOL, via CALL) (Part 1 of 2)

Examples

```
           CALL "FmcjReadWriteContainerSetLongValue"
              USING BY VALUE hdlContainer
                             qualifiedName
                             intValue
              RETURNING intReturnValue.
           MOVE intReturnValue TO retCode.
           DISPLAY "Setting long value returns rc: " retCode.

      * return the output container
           CALL "FmcjContainerSetOutContainer"
              USING BY VALUE outputValue
              RETURNING intReturnValue.
           MOVE intReturnValue TO retCode.
           DISPLAY "Set Output Container - rc: " retCode.

           CALL "FmcjGlobalDisconnect".
           MOVE FMC-OK TO retCode.
           GOBACK.

           COPY fmcperf.
```

Figure 70. Sample activity implementation (COBOL, via CALL) (Part 2 of 2)

Glossary

This glossary defines terms and abbreviations used in MQSeries Workflow for OS/390 publications. If you do not find the term you are looking for, refer to the index of the appropriate manual or view the *IBM Dictionary of Computing* located at:

`http://www.ibm.com/networking/nsg/nsgmain.htm`

A

administration server. The MQ Workflow component that performs administration functions within an MQ Workflow system. Functions include starting and stopping of the MQ Workflow system, performing error management, and participating in administrative functions for a system group.

activity. One of the steps that make up a process model. This can be a program activity, process activity, or block activity.

activity information member. A predefined data structure member associated with the operating characteristics of an activity.

API. Application Programming Interface.

applet. An application program, written in the Java programming language, that can be retrieved from a Web server and executed by a Web browser. A reference to an applet appears in the markup for a Web page, in the same way that a reference to a graphics file appears; a browser retrieves an applet in the same way that it retrieves a graphics file. For security reasons, an applet's access rights are limited in two ways: the applet cannot access the file system of the client upon which it is executing, and the applet's communication across the network is limited to the server from which it was downloaded. Contrast with servlet.

application programming interface. An interface provided by the MQ Workflow workflow manager that enables programs to request services from the MQ Workflow workflow manager.

asynchronous API call. A particular service of the API that allows programs to register functions with the API that are invoked when a defined event is found by MQ Workflow.

audit trail. A relational table in the database that contains an entry for each major event during execution of a process instance.

authorization. The attributes of a user's staff definition that determine the user's level of authority in MQ Workflow. The system administrator is allowed to perform all functions.

B

backward mapping. Conversion of output data created by an OS/390 legacy application into an MQSeries Workflow container. This conversion is performed by the *program execution server's program mapper*.

backward mapping definition. Part of the *MDL* which connects an interface definition and structure definition.

bend point. A point at which a connector starts, ends, or changes direction.

block activity. A composite activity that consists of a group of activities, which can be connected with control and data connectors. A block activity is used to implement a Do-Until loop; all activities within the block activity are processed until the exit condition of the block activity evaluates to true. See also *composite activity.*

Buildtime. An MQ Workflow component with a graphical user interface for creating and maintaining workflow models, administering resources, and the system network definitions.

C

cardinality. (1) An attribute of a relationship that describes the membership quantity. There are four types of cardinality: One-to-one, one-to-many, many-to-many, and many-to-one. (2) The number of rows in a database table or the number of different values in a column of a database table.

child organization. An organization within the hierarchy of administrative units of an enterprise that has a parent organization. Each child organization can have one parent organization and several child organizations. The parent is one level above in the hierarchy. Contrast with *parent organization*.

cleanup server. The MQ Workflow component that physically deletes information in the MQ Workflow Runtime database, which had only been deleted logically.

composite activity. An activity which is composed of other activities. Composite activities are block activities and bundle activities.

container API. An MQ Workflow API that allows programs executing under the control of MQ Workflow to obtain data from the input and output container of the activity and to store data in the output container of the activity.

control connector. Defines the potential flow of control between two nodes in the process. The actual flow of control is determined at run time based on the truth value of the transition conditions associated with the control connector.

coordinator. A predefined role that is automatically assigned to the person designated to coordinate a role.

CPIC. An invocation type that allows the program execution server to run an application synchronously on an IMS service. CPIC is based on IMS/APPC.

D

data connector. Defines the flow of data between containers.

data container. Storage for the input and output data of an activity or process. See *input container* and *output container*.

data mapping. Specifies, for a data connector, which fields from the associated source container are mapped to which fields in the associated target container.

data structure. A named entity that consists of a set of data structure members. Input and output containers are defined by reference to a data structure and adopt the layout of the referenced data structure type.

data structure member. One of the variables of which a data structure is composed.

default control connector. The graphical representation of a standard control connector, shown in the process diagram. Control flows along this connector if no other control path is valid.

document type definition (DTD). The rules, determined by an application, that apply SGML to the markup language of documents of a particular type. SGML provides the syntax for the markup language, and the DTD provides the vocabulary for the markup language.

domain. A set of MQ Workflow system groups which have the same meta-model, share the same staff information, and topology information. Communication between the components in the domain is via message queuing.

dynamic staff assignment. A method of assigning staff to an activity by specifying criteria such as role, organization, or level. When an activity is ready, the users who meet the selection criteria receive the activity to be worked on. See also *level*, *organization*, *process administrator*, and *role*.

E

end activity. An activity that has no outgoing control connector.

EXCI. An invocation type that allows the program execution server to run an application synchronously on a CICS service. EXCI is based on the CICS External CICS Interface provided by CICS Version 4.1 and higher to allow non-CICS applications to call programs running under CICS.

execution server. The MQ Workflow component that performs the processing of process instances at runtime.

exit condition. A logical expression that specifies whether an activity is complete.

export. An MQ Workflow utility program for retrieving information from the MQ Workflow database and making it available in MQ Workflow Definition Language (FDL) or HTML format. Contrast with *import*.

F

fixed member. A predefined data structure member that provides information about the current activity. The value of a fixed member is set by the MQ Workflow workflow manager.

(FDL) MQ Workflow Definition Language. The language used to exchange MQ Workflow information between MQ Workflow system groups. The language is used by the import and export function of MQ Workflow and contains the workflow definitions for staff, programs, data structures, and topology. This allows non-MQ Workflow components to interact with MQ Workflow. See also *export* and *import*.

FlowMark. The predecessor of MQSeries Workflow.

fork activity. An activity that is the source of multiple control connectors.

forward mapping. Conversion of MQSeries Workflow containers into a format accepted by an OS/390 legacy application. This conversion is performed by the *program execution server's program mapper*.

forward mapping definition. Part of the *MDL* which connects a structure definition and interface definition.

fully-qualified name. A qualified name that is complete; that is, one that includes all names in the

hierarchical sequence above the structure member to which the name refers, as well as the name of the member itself.

I

import. An MQ Workflow utility program that accepts information in the MQ Workflow definition language (FDL) format and places it in an MQ Workflow database. Contrast with *export*.

input container. Storage for data used as input to an activity or process. See also *source* and *data mapping*.

interface. The definition of the data structure accepted by an OS/390 CICS or IMS legacy application. This definition is used by the *program mapper* to convert data to (and from) an MQSeries Workflow program's *structure*.

interface definition. Part of the *MDL* which defines the interface used by a legacy application.

interface element. Part of an *interface* definition. An interface element has a name, a type and a cardinality. It is mapped onto a *structure* element by a *mapping rule*.

invocation exit. The DLL specified by the invocation type. The exit is based on an invocation protocol like CICS External CICS Interface, IMS/APPC or the MQSeries CICS and IMS bridges.

invocation protocol. The way the PES connects to a service like CICS or IMS in order to invoke a program on that service.

invocation type. The way the program execution server connects to a service system (like CICS or IMS) in order to invoke a program on that service. The invocation type is part of a program mapping execution request sent to the PES. To invoke a program, the PES loads the appropriate invocation exit as defined for the invocation type. Invocation types include *EXCI* and *CPIC*.

L

level. A number from 0 through 9 that is assigned to each person in an MQ Workflow database. The person who defines staff in Buildtime can assign a meaning to these numbers such as rank and experience. Level is one of the criteria that can be used to dynamically assign activities to people.

local user. Identifies a user during staff resolution whose home server is in the same system group as the originating process.

local subprocess. A subprocess that is processed in the same MQ Workflow system group as the originating process.

logical expression. An expression composed of operators and operands that, when evaluated, gives a result of true, false, or an integer. (Nonzero integers are equivalent to false.) See also *exit condition* and *transition condition*.

M

manager. A predefined role that is automatically assigned to the person who is defined as head of an organization.

mapping definition language. The language used to define *mapping definitions* for the *program mapping exit*.

mapping exit. Used by the PES to convert data between MQSeries Workflow and legacy applications. The exit is defined by a mapping type defined in the *PES directory* and in *Buildtime*. The exit is only called if mapping has been enabled in *Buildtime*.

mapping rules. Part of a *forward mapping* or *backward mapping* definition that defines the mapping between individual *interface elements* and *structure elements*. Mapping rules are defined using the *mapper definition language*.

mapping type. The name used to identify which mapping exit to use. The mapping type is defined in the *PES directory* and must match the *Buildtime* definitions for the legacy application. The mapping type provided with MQSeries Workflow for OS/390 is named **DEFAULT**.

MDL. See *mapping definition language*.

message queuing. A communication technique that uses asynchronous messages for communication between software components.

MQCICS. An invocation type that allows the program execution server to run an application asynchronously on a CICS service. The corresponding invocation exit uses the MQSeries CICS Bridge as invocation protocol.

MQIMS. An invocation type that allows the program execution server to run an application asynchronously on an IMS service. The corresponding invocation exit uses the invocation protocol MQSeries IMS Bridge.

N

navigation. Movement from a completed activity to subsequent activities in a process. The paths followed are determined by control connectors, their associated transition conditions, and by the start conditions of activities. See also *control connector*, *exit condition*, *transition condition*, and *start condition*.

node. (1) The generic name for activities within a process diagram. (2) The operating system image that hosts MQ Workflow systems.

notification. An MQ Workflow facility that can notify a designated person when a process or activity is not completed within the specified time.

notification work item. A work item that represents an activity or process notification.

O

organization. An administrative unit of an enterprise. Organization is one of the criteria that can be used to dynamically assign activities to people. See *child organization* and *parent organization*.

output container. Storage for data produced by an activity or process for use by other activities or for evaluation of conditions. See also *sink*.

P

parent organization. An organization within the hierarchy of administrative units of an enterprise that has one or more child organizations. A child is one level below its parent in the hierarchy. Contrast with child *child organization*.

parent process. A process instance that contains the process activity which started the process as a subprocess.

pattern activity. A single and simple activity in a bundle activity from which multiple instances, called pattern activity instances, are created at run time.

person (pl. people). A member of staff in an enterprise who has been defined in the MQ Workflow database.

PES. See *program execution server*.

PES directory. See *program execution server directory*.

predefined data structure member. A data structure member predefined by MQ Workflow and used for communication between user applications and MQ Workflow Runtime.

process. Synonymously used for a process model and a process instance. The actual meaning is typically derived from the context.

process activity. An activity that is part of a process model. When a process activity is executed, an instance of the process model is created and executed.

process administrator. A person who is the administrator for a particular process instance. The administrator is authorized to perform all operations on a process instance. The administrator is also the target for staff resolution and notification.

process category. An attribute that a process modeler can specify for a process model to limit the set of users who are authorized to perform functions on the appropriate process instances.

process definition. Synonym for *process model*.

process diagram. A graphical representation of a process that shows the properties of a process model.

process instance. An instance of a process to be executed in MQ Workflow Runtime.

process instance list. A set of process instances that are selected and sorted according to user-defined criteria.

process instance monitor. An MQ Workflow client component that shows the state of a particular process instance graphically.

process management. The MQ Workflow Runtime tasks associated with process instances. These consist of creating, starting, suspending, resuming, terminating, restarting, and deleting process instances.

process model. A set of processes represented in a process model. The processes are represented in graphical form in the process diagram. The process model contains the definitions for staff, programs, and data structures associated with the activities of the process. After having translated the process model into a process template, the process template can be executed over and over again. *Workflow model* and *process definition* are synonyms.

process monitor API. An application programming interface that allows applications to implement the functions of a process instance monitor.

process-relevant data. Data that is used to control the sequence of activities in a process instance.

process status. The status of a process instance.

process template. A fixed form of a process model from which process instances can be created. It is the translated form in MQ Workflow Runtime. See also *process instance*.

process template list. A set of process templates that have been selected and sorted according to user-defined criteria.

program. A computer-based application that serves as the implementation of a program activity or as a support tool. Program activities reference executable programs using the logical names associated with the programs in MQ Workflow program registrations. See also *program registration*.

program activity. An activity that is executed by a registered program. Starting this activity invokes the program. Contrast with *process activity*.

program execution agent (PEA). An MQ Workflow component that manages the implementations of program activities for a user in a LAN environment. Each instance of a program execution agent services a single user. MQSeries Workflow for OS/390 does not support program execution agents but rather employs a program execution server.

program execution server (PES). An MQ Workflow component that can manage the implementations of program activities for multiple clients. OS/390 employs a program execution server to implement CICS and IMS programs and to support mapping of data formats between MQSeries Workflow and legacy applications. Multiple instances of a program execution server are possible. In the LAN environment, program execution agents are used instead of program execution servers.

program mapping. Program mapping definitions passed and supported into the mapping database and used by the program mapper at runtime to transform data from legacy applications.

program mapping DB. Database used by the PES exit which contains program mappings imported by the program mapping import tool. Used at runtime by the exit to perform the forward and backward mapping.

program mapping exit. PES exit used to transform MQSeries Workflow for OS/390 containers into a format acceptable by legacy applications and vice versa.

program mapping import tool. Component of the MQSeries Workflow program mapping exit which reads the result of the program mapping parser and inputs the compiled program mapping definitions into the program mapping DB.

program mapping parser. Component of the MQSeries Workflow for OS/390 program mapping exit which parses the MDL and creates an intermediate file which is used by the program mapping import tool.

program registration. Registering a program in MQ Workflow so that sufficient information is available for managing the program when it is executed by MQ Workflow.

R

role. A responsibility that is defined for staff members. Role is one of the criteria that can be used to dynamically assign activities to people.

S

scheduling server. The MQ Workflow component that schedules actions based on time events, such as resuming suspended work items, or detecting overdue processes.

server. The servers that make up an MQ Workflow system are called Execution Server, Administration Server, Scheduling Server, and Cleanup Server.

servlet. An application program, written in the Java programming language, that is executed on a Web server. A reference to a servlet appears in the markup for a Web page, in the same way that a reference to a graphics file appears. The Web server executes the servlet and sends the results of the execution (if there are any) to the Web browser. Contrast with applet.

sink. The symbol that represents the output container of a process or a block activity.

source. The symbol that represents the input container of a process or a block activity.

specific resource assignment. A method of assigning resources to processes or activities by specifying their user IDs.

standard client. The MQ Workflow component, which enables creation and control of process instances, working with worklists and work items, and manipulation of personal data of the logged-on user.

start activity. An activity that has no incoming control connector.

start condition. The condition that determines whether an activity with incoming control connectors can start after all of the incoming control connectors are evaluated.

structure. The definition of the MQSeries Workflow structure passed into or out of an *activity* implementation.

structure definition. Part of the *MDL* which defines the structure used by a program activity.

structure element. Part of an *structure* definition. A structure element has a name, a type and a cardinality. It is mapped onto an *interface* element by a *mapping rule*.

subprocess. A process instance that is started by a process activity.

substitute. The person to whom an activity is automatically transferred when the person to whom the activity was originally assigned is declared as absent.

support tool. A program that end users can start from their worklists in the MQ Workflow MQ Workflow Client to help complete an activity.

symbolic reference. A reference to a specific data item, the process name, or activity name in the description text of activities or in the command-line parameters of program registrations. Symbolic references are expressed as pairs of percent signs (%)

that enclose the fully-qualified name of a data item, or either of the keywords _PROCESS or _ACTIVITY.

system. The smallest MQ Workflow unit within an MQ Workflow domain. It consists of a set of the MQ Workflow servers.

system group. A set of MQ Workflow systems that share the same database.

system administrator. (1) A predefined role that conveys all authorizations and that can be assigned to exactly one person in an MQ Workflow system. (2) The person at a computer installation who designs, controls, and manages the use of the computer system.

T

thin client. A client that has little or no installed software but has access to software that is managed and delivered by network servers that are attached to it. A thin client is an alternative to a full-function client such as a PC.

top-level process. A process instance that is not a subprocess and is started from a user's process instance list or from an application program.

transition condition. A logical expression associated with a conditional control connector. If specified, it must be true for control to flow along the associated control connector. See also *control connector*.

translate. The action that converts a process model into a Runtime process template.

trusted program. A program that has been assigned such a characteristic in the FDL (via Buildtime), which enables a PEA or PES to divulge the program ID.

U

Unicode. A system of 16 bit binary codes for text or script characters. Officially called the Unicode Worldwide Character Standard, it is a system for ″the interchange, processing, and display of the written texts of the diverse languages of the modern world″. Unicode is used by the Java programming language for character representation.

user-defined program execution server (UPES). A program listening on a user-defined MQSeries queue and effectively acting as a program execution server by accepting and implementing program invocation requests received from external programs in the form of XML messages.

user ID. An alphanumeric string that uniquely identifies an MQ Workflow user.

user type definition. Part of the *MDL* which defines the interface used by a user type.

user type interface. A user defined interface type. If you need to map a data type that is not supported by the default mapper type, you can define a user type, and write a type conversion program which handles the conversion of the particular data type. This must use the user type exit.

V

verify. The action that checks a process model for completeness.

W

workflow. The sequence of activities performed in accordance with the business processes of an enterprise.

Workflow Management Coalition (WfMC). A non-profit organization of vendors and users of workflow management systems. The Coalition's mission is to promote workflow standards for workflow management systems to allow interoperability between different implementations.

workflow model. Synonym for *process model*.

work item. Representation of work to be done in the context of an activity in a process instance.

work item set of a user. All work items assigned to a user.

worklist. A list of work items and notifications assigned to a user and retrieved from a workflow management system.

worklist view. List of work items selected from a work item set of a user according to filter criteria which are an attribute of a worklist. It can be sorted according to sort criteria if specified for this worklist.

Bibliography

To order any of the following publications, contact your IBM representative or IBM branch office.

MQSeries Workflow for OS/390 publications

This section lists the publications included in the MQSeries Workflow for OS/390 library.

- *MQSeries Workflow for OS/390: Customization and Administration*, SC33-7030, explains how to customize and administer an MQSeries Workflow for OS/390 system.
- *MQSeries Workflow for OS/390: Programming Guide*, SC33-7031, explains the application programming interfaces (APIs) available on OS/390, including program execution server exits.
- *MQSeries Workflow for OS/390: Messages and Codes*, SC33-7032, explains the MQSeries Workflow for OS/390 system messages.
- *MQSeries Workflow for OS/390: Program Directory*, GI10-0483, explains how to install MQSeries Workflow for OS/390.

MQSeries Workflow publications

This section lists the publications included in the MQSeries Workflow library.

- *IBM MQSeries Workflow: List of Workstation Server Processor Groups*, GH12-6357, lists the processor groups for MQSeries Workflow.
- *IBM MQSeries Workflow: Concepts and Architecture*, GH12-6285, explains the basic concepts of MQSeries Workflow. It also describes the architecture of MQSeries Workflow and how the components fit together.
- *IBM MQSeries Workflow: Getting Started with Buildtime*, SH12-6286, describes how to use Buildtime of MQSeries Workflow.
- *IBM MQSeries Workflow: Getting Started with Runtime*, SH12-6287, describes how to get started with the Client.
- *IBM MQSeries Workflow: Programming Guide*, SH12-6291, explains the application programming interfaces (APIs).
- *IBM MQSeries Workflow: Installation Guide*, SH12-6288, contains information and procedures for installing and customizing MQSeries Workflow.
- *IBM MQSeries Workflow: Administration Guide*, SH12-6289, explains how to administer an MQSeries Workflow system.

Workflow publications

- *IBM Systems Journal, Vol. 36. No. 1, 1997 by Frank Leymann, Dieter Roller.* You can also refer to the Internet:

  `http://www.almaden.ibm.com/journal/sj361/leymann.html`
- *Workflow Handbook 1997, published in association with WfMC*. Edited by Peter Lawrence.

MQSeries publications

- *MQSeries System Administration*, SC33-1873, explains administration tasks related to MQSeries.
- *MQSeries Installation*, SH12-6288, discusses the installation of MQSeries.
- *MQSeries System Administration*, SC33-0807, discusses topics related to the application programming interface of MQSeries.

Other useful publications

- *MQSeries Clients*, GC22-1632
- *DB2 for OS/390 Administration Guide*, SC26-8957
- *DB2 for OS/390 SQL Reference*, SC26-8966
- *DB2 for OS/390 Application Programming and SQL Guide*, SC26-8958
- *DB2 for OS/390 Command Reference*, SC26-8960
- *DB2 for OS/390 Utility Guide and Reference*, SC26-8967
- *OS/390 MVS Planning: Workload Management*, GC28-1761
- *OS/390 MVS Programming: Workload Management Services*, GC28-1773
- *W3C Recommendation: Extensible Markup Language (XML) 1.0*, REC-xml-19980210

Licensed books

The licensed books that were declassified in OS/390 Version 2 Release 4 appear on the OS/390 Online Library Collection, SK2T-6700. The remaining licensed books for OS/390 Version 2 appear on the OS/390 Licensed Product library, LK2T-2499, in unencrypted form.

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IBM MQSeries Workflow for OS/390
Programming Guide

Publication No. SC33-7031-03

Overall, how satisfied are you with the information in this book?

	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
Overall satisfaction	☐	☐	☐	☐	☐

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Easy to find	☐	☐	☐	☐	☐
Easy to understand	☐	☐	☐	☐	☐
Well organized	☐	☐	☐	☐	☐
Applicable to your tasks	☐	☐	☐	☐	☐

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Readers' Comments — We'd Like to Hear from You
SC33-7031-03

Cut or Fold
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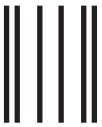

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